Materials Engineering in Product Design & Manufacture

Materials & Methods

October 1953

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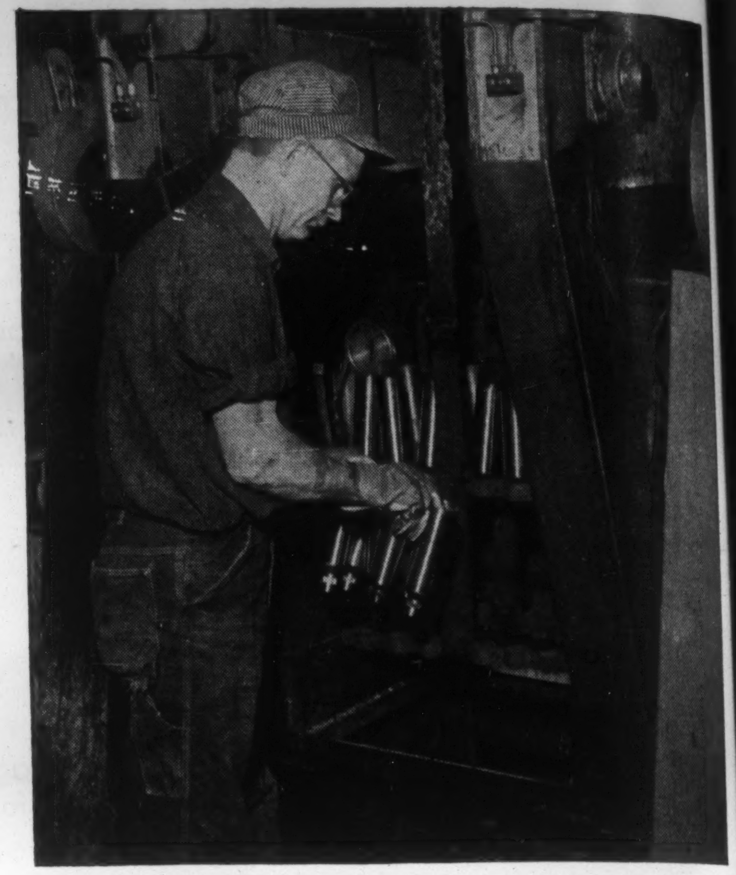

This worker is loading rocket motor bodies on the conveyor to the mechanized neutral salt bath. The fixture holding the parts is made of Inconel, weighs 20 lbs. Fixtures were designed and fabricated by **The Brown-Hutchinson Iron Works**, Detroit, who did the development work. They have given a service life of 4,300 hours.

These Fixtures last 12 Times Longer *...in a salt bath*

The heat treating phase in the manufacture of a high production item has to keep pace with the rest of the line.

A major auto producer, engaged in arms manufacturing, keeps production flowing in a straight line operation. Here rocket motor bodies for 3.5 inch bazooka shells are sent through a mechanized neutral salt bath to be heat treated for additional strength and shock resistance. The units are placed on Inconel® fixtures, fabricated by The Brown-Hutchinson Iron Works, and sent through a cycle ranging from processing at 1550°F. down to hot water rinses.

The fixtures gave excellent service under these conditions. They were still serviceable after 4,300 work hours.

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The Materials Outlook

A new polyester resin makes possible polyester-glass reinforced plastics with fire resistance far superior to that of conventional polyesters. Hitherto, fire resistance has been imparted by large additions of pigment which reduce appreciably the mechanical properties of the plastic. In the new resin, the fire resistance is inherent in the molecule, although it is also improved by small additions of pigment. In addition to fire resistance, the new polyester is said to offer superior strength retention at elevated temperatures.

Greater application of aluminum to pressure vessels is foreseen with the listing of five additional aluminum sheet and plate alloys in the latest ASME Boiler and Pressure Vessel Code. Previously, only 2S and 3S aluminum alloys were listed. Now they have been augmented by 4S, 50S, 52S, 61S and a new high-purity, highly corrosion-resistant alloy.

Boron steels machined as well as or better than their higher alloy standard steel equivalents in recent tests conducted under an Ordnance contract. The report suggested that even better results might be obtained by heat treatments designed to produce the same microstructure that is present in the standard steels.

New developments in powder metallurgy: More uniform density is being achieved in one plant by centrifugal compacting as opposed to pressing. . . . Hot pressed compacts of 1200 lb have been produced and one company claims it could produce 4000-lb compacts without significant changes in equipment now available.

A new phenolic-alkyd baking enamel which can be applied from a water solution, thus eliminating ordinary paint hazards and the need for a solvent recovery system, has been introduced. For more details on this protective coating, including the changes in normal processing that would be required, see the brief article on p 7 of this issue.

Ductile iron bar stock is now being produced. Bars are available in 12-in. lengths and seven diameters ranging from 1¼ to 6 in. As-cast average properties claimed are: 100,000 psi tensile strength, 65,000 psi yield, 3½-4½% elongation and 245 Brinell hardness.

Refinements of the barrel tumbling process designed to make it more widely applicable have led finally to something faintly resembling an old style washing machine that actually doesn't tumble at all. A tub containing tumb-

(Continued on page 4)

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The Materials Outlook *(continued)*

ling chips and compounds spins on a vertical axis. The metal parts are mounted individually on pistons which plunge into the abrasive load and rotate each part to insure even chip action. Future models will probably have the piston mount turning counter to the tub rotation.

Best indication of a growing future for plastic pipe is the way some steel companies have been snapping up plastic pipe producers. At last count there were three important steel companies in the plastics field.

The problem of porosity usually associated with leather seals seems to have been overcome by a new material consisting of leather impregnated partly or fully with Thiokol liquid polymers. Compared to the traditional wax impregnations, the elastomer impregnations appear to offer longer life and lower leakage. The superiority is pronounced at elevated temperatures. Details are given on p. 127 of this issue.

Two new developments in tool steels — both aimed at lowering tungsten content: One is a tool steel containing no tungsten at all, developed mainly in case tungsten gets too scarce. Basically titanium carbide, it is claimed to perform in some cases as well as regular grades. The other is a tool steel in which tungsten content has been reduced from 12% to 2½%, with the vanadium content hiked to 4%. It gives high-speed performance at a significantly lower cost due to savings in costly tungsten.

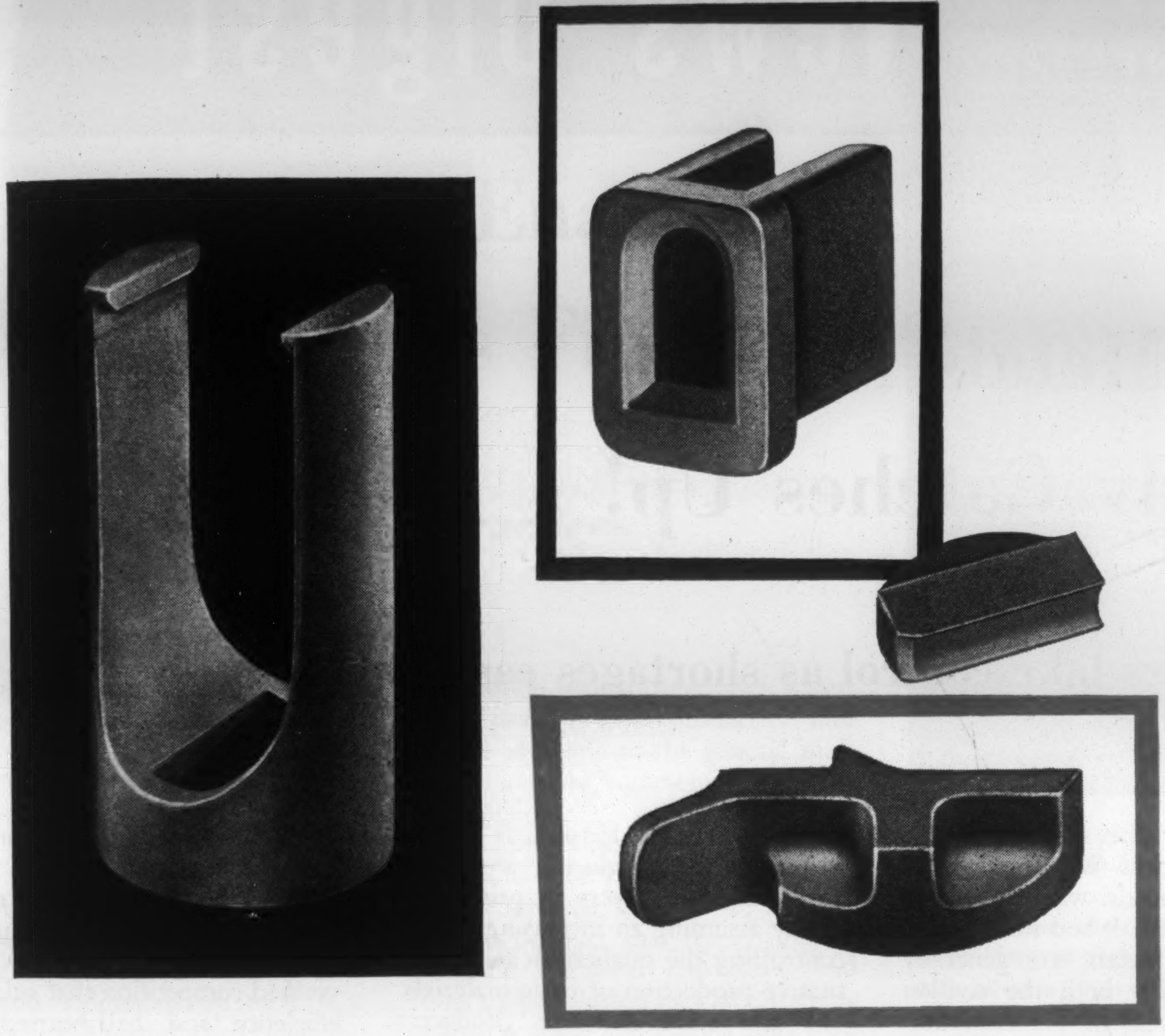
An insulating rosin flux is now being used to prevent "hum" in radio and TV receivers caused by conductivity in printed circuit base materials. The coating also protects the copper or silver circuit from oxidation, making the use of highly activated fluxes for tinning unnecessary.

A powdered form of reclaimed rubber, selling for about 10% less than the conventional slabs, is now on the market. Claimed to be suitable for molded mechanical goods, this form is expected to offer advantages in shipping and conveying.

It doesn't pay to use untried or scientifically unsound anti-corrosion devices in expensive processing equipment, says the NACE-sponsored Inter-Society Corrosion Committee. Serious damage may result, including personal injuries or death. The committee recommends that only proven devices on which quantitative data is available be used.

On-the-spot spectrography may be getting more practical for the small firm. Low cost machines capable of analyzing a wide variety of materials have recently been put on the market.

Close-tolerance matte surfaces can be produced on metals by a carefully controlled high pressure abrasive spray. The new method makes it possible to avoid overly smooth surfaces which promote friction and seizing without producing surfaces as non-uniform as those usually produced by conventional blasting processes.



improve product design . . .
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In many cases design is restricted and function limited when alloy steel parts are made on conventional machinery from bar stock or forgings. Frequently such designs can be improved and production costs lowered by the use of precision investment castings. That's because this casting process permits the use of high alloy steels that are difficult to machine or forge.

Take these four component parts of a pneumatic tool for example. They are Accumet Investment Castings made by Crucible of 8620 steel. They have a smooth, satiny finish and are held to very close tolerances. If these parts were not made by this "lost wax" process, the pneumatic tool could not be produced at a practical cost in its present design.

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The Metals Market: Supply Catches Up!

Buyers take control as shortages ease

For virtually the first time since the second World War, sources of supply of all metals, with the exception of nickel, cobalt and some of the newest "rare" metals, are generally sufficient to serve both the civilian and military needs of the American economy. The general outlook, barring another Korea or similar national emergency, is towards increasing stability of production and prices with materials buyers in private industry assuming an increasing role in controlling the qualitative and quantitative production of basic materials.

While some materials producers are highly concerned over what appears to be a slackening demand, and issue dire warnings of industrial decline because of steady or softening prices, it appears more and more that much of the wailing is due to the unpleasant necessity of meeting a revivified competition that rules out inefficiency and half-hearted service. The pessimistic attitude is not by any means universal in the material supply picture, however. Many producers see in the leveling off period a chance to retire old, inefficient machinery that has been producing on very low margin, and to catch up on overdue maintenance that has lagged in the rush to produce at overcapacity levels.

Steels

Steel production at below-capacity levels has caused a great deal of concern in some circles, particularly when the fourth quarter order books were exceptionally slow in filling this year. However, steel buyers know that they can get what they want, when and where they want it. They are in no hurry to tie themselves up with orders far in the future when it appears that prices may come down.

Expensive conversion steel has gone begging this fall, with some converters reporting declines as much as 70%, but the demand for cold rolled sheets and structural forms is still brisk and mill order books are loaded.

With the decline in farm machinery production and defense stretchouts, alloy steel supplies have eased to the point where some manufacturers have shut down a few electric furnaces.

In early September steel production dropped below 90% of capacity for

(Continued on page 232)

What They Said . . . . . .

MARGIN . . . "an increase of only 5% in the civilan standard of living could more than offset the drop of about $10 billion in government defense expenditures which may take place late this year or in 1954." Arno Johnson, Research Director, J. Walter Thompson.

ENERGY . . . "We have every confidence that scientists and engineers will inevitably solve the technical and practical problems standing between us and the wide scale production of electric power from atomic energy. What we have already accomplished is to make certain that the nation in the forseeable future has no need to fear the exhaustion of its natural energy supplies, almost regardless of how magnificently we continue to increase our standard of living and defense potentials." F. K. Mc Cune, General Electric Co., July 9, 1953.

NO ISOLATION . . . "There are only two metals for which our domestic production meets all our needs: these are magnesium and molybdenum. Of 74 categories of 'strategic and critical' materials listed by the Munitions Board, we import *all* our supplies in more than 40 and *part* of our supplies in virtually all the rest." Eric Hodgins, Board of Editors, *Fortune*, June 16, 1953.

STEEL RESEARCH "For many, many years research has been a very minor constituent of the steel industry. I am afraid that to many industrial leaders it appears to be an unimportant constituent. This, however, is a very superficial view. The more deeply one looks into the real problems of steel manufacture the more one becomes convinced that our hope of solving these problems lies in research."—*John Chipman, Head, Metallurgy Dept., Mass Institute of Technology, May 27, 1953.*

Water Soluble Enamel Enters Coatings Field

Challenges Standard Practices

A recently perfected water soluble plasticized phenolic resin baking enamel promises to reduce baked enamel finishing costs and eliminate many fire and toxic hazards in paint shops. The new enameling process substitutes plain tap water for expensive organic solvents which make up about 50% of the volume of conventional baking enamels, resulting in cost reductions up to 25%, according to the manufacturer, Reichhold Chemicals, Inc. The enamel which will be marketed as Hydrophen, is a phenolic-alkyd-ammonia compound which forms a true aqueous solution when diluted with water. It has been in pilot production and will be available to the general market as soon as commercial facilities are readied.

In a special interview with M&M, Reichhold vice president of technological research Thomas P. Brown, stressed the fact that the enameling materials combine chemically and form a true solution in water, thereby casting a more continuous film than that obtained from emulsion mixtures. Brown also pointed out that the phenolic enamel is only the first

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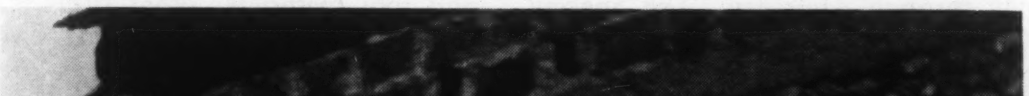
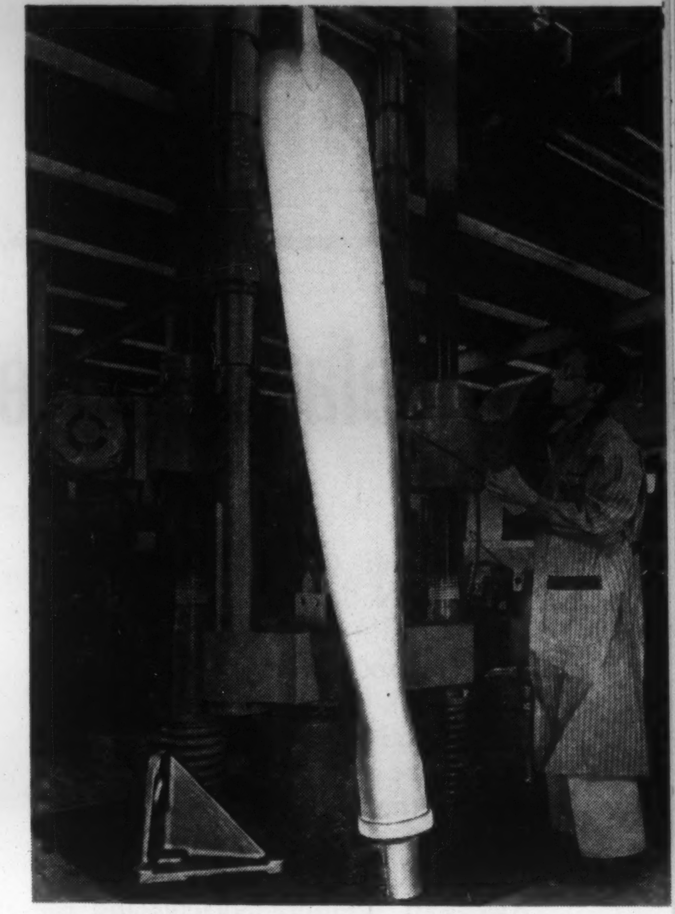


Technician coats and cures a test panel with non-flammable, water-soluble baking enamel to demonstrate how a combination flame and spray apparatus can be used in the field to coat large finished structures. The process was used successfully in Europe to coat condensation towers subject to corrosive atmospheres. The spray-flame gun is a product of Gerhard Collardin GMBH, Cologne.



Titanium Forging. This 100 in. propeller blade, made for an Air Force propeller research program, is the largest titanium alloy drop forging ever made. Use of forged titanium reportedly offers a 40% weight saving in this application. The blade will compete in a series of tests as part of a program to develop larger, lighter and stronger propellers for turboprop engines.

Ladish Co.

Welding Society Announces Meeting

The 1954 National Spring Technical Meeting of the American Welding Society will take place in Buffalo N. Y., May 4-7. The AWS has leased the Buffalo Memorial Auditorium for the Welding and Allied Industries Exposition where display space will be available for manufacturers and suppliers.

The 1953 meeting of the AWS in Houston, Texas was the first devoted exclusively to welding and allied fields and its success indicates that the 1954 meeting, which will be held closer to the geographic center of American and Canadian industry will be heavily attended.

The Buffalo Statler will be the Society Headquarters Hotel and accommodations for attendees will be reserved at all other leading Buffalo hotels.

Details of the meeting and display space available will be mailed to industry in early November .

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PREVIEW

Cleveland Scene of 1953 Metal Exposition

Cleveland, Ohio will play host to the 34th National Metal Conference and Exposition and members of participating societies on the week of October 17th. Joint sponsors of the annual Metal Show, as it is popularly called, are the American Society for Metals, the Institute of Metals Div. of the American Institute of Mining and Metallurgical Engineers, the American Welding Society, and the Society for Non-Destructive Testing.

Exhibits

Over 460 firms, representing a cross section of the portion of American industry engaged in the production, treatment and fabrication of metals or in serving these industries, have leased space for exhibits in Cleveland's spacious Public Auditorium. Exhibits will occupy an area roughly equivalent to five football fields; 210,000 sq ft of floor space.

Large supplementary areas in the Cleveland Public Auditorium have been reserved as lecture and meeting areas for the use of participants in order to keep the Metal Show as centralized as possible.

The Eighth Metallographic Exhibit of the American Society for Metals will be held concurrently with the Exposition and will be located in the Public Auditorium along with the commercial exhibits. All work appearing in the exhibit will be new, since photomicrographs which have been displayed in previous ASM Metallographic Exhibits are not acceptable.

Technical Sessions

The ASM technical lectures will be held in the ballroom of the Cleveland Public Auditorium, on Monday through Wednesday. The Special Libraries Association will take over the ballroom for the balance of the Congress for its fall meeting program. Each of the sponsoring societies will have headquarters in one of the Cleveland hotels: the American Society for Metals will be at the Statler Hotel; the American Welding Society at the Hotel Cleveland; the Institute of Metals Div. of the American Institute of Mining and Metallurgical Engineers at the Hotel Allerton; and the Society of Non-Destructive Testing at the Hotel Hollenden.

The American Society for Metals will hold its annual Seminar in morning and afternoon sessions on Saturday and Sunday October 17 and 18. The subject of the seminar this year will be "Relation of Properties to Microstructure".

Throughout the entire week of the Congress, the ASM and the American Welding Society will hold morning and afternoon technical sessions. The Institute of Metals Div., AIME, will hold daily sessions during the day and in the evening Monday through Wednesday. The Society for Non-Destructive Testing will hold morning and afternoon sessions Monday through Thursday. The Special Library Association will have a field trip to Battelle Memorial Institute on Wednesday and will hold its meetings on Thursday and Friday.

Other Activities

The annual meeting of the ASM will be held Wednesday morning, at which time Donald S. Clark of the California Institute of Technology will deliver the Campbell Memorial Lecture.

Members of the AWS will hear the presidential address and the annual Adams Lecture on Monday morning. The 1953 Adams Lecture will be delivered by R. B. Shepheard of the Shipbuilding Conference on: "Aspects of Welding Research in British Merchant Shipbuilding." A series of three educational lectures will be delivered at 4:30 PM Monday, Tuesday and Wednesday. Two field trips have been scheduled—one to the Cleveland Tank plant of Cadillac Motor Car Div., GMC and the other to Euclid Road Machinery Co. Technical sessions on titanium are expected to create a great deal of interest this year.

This year marks the thirteenth annual meeting of the Non-Destructive Testing Society and the tenth to be held in conjunction with the ASM. For the first time, two awards will be given for the most outstanding papers of the last year. The awards will be the Coolidge Award by General Electric X-ray Dept. and the de Forest Award given by the Magnaflux Corp. Also for the first time, the society is planning a series of educational lectures, to be held on Monday. Highlights of the SNT technical sessions are expected to be papers on radioisotopes including Cesium 137 and discussions of ultrasonic and magnetic techniques in inspection.

As in the past, the Metallographic Exhibit will be held in the form of a contest and awards will be given to the best entries in each classification. Eleven classifications of micros have been designated this year: tool steels and tool materials; other steels and irons; aluminum, magnesium, beryllium, titanium, and their alloys; metals and alloys not otherwise classified; series of photomicrographs showing transition changes during processing; surface phenomena; results by unconventional photomicrographic techniques (other than electron microscopy); slags, oxides and inclusions; welds and other joining methods.

A committee of judges appointed by the Metal Congress Management will award a first prize consisting of a medal and blue ribbon to the best entry in each classification. A grand prize of $100 and a certificate will be awarded to the exhibitor of the entry judged best in show. The prize entry will go to the ASM for permanent preservation and display in the Society's headquarters.

Please turn to page 13 for the Correlated Program, and to page 15 for List of Exhibitors

How to Descale Titanium

On the basis of (1) lack of embrittlement and (2) low metal loss, specially compounded molten caustic baths seem to offer the most.

by **A. E. DURKIN,** Thomson Laboratory, General Electric Co.

• A MAJOR DIFFICULTY in the use of titanium alloys is the removal of oxides formed during heat treating and forging operations. When these oxides are not removed, the corrosion resistance of the metal is decreased. It cannot be readily welded and its ductility is materially reduced. This article will discuss descaling techniques and show that many oxide formations can be removed if the proper descaling process and cycle is used.

When titanium metal is heated in air, a tight oxide scale forms on its surface. This scale consists largely of titanium dioxide (TiO_2), but it also contains some of the lower oxides in the areas adjacent to the titanium surface. The visual appearance of the scales formed on titanium by heating between 600 and 1700 F is shown in Table 1.

The solubility of the oxides in both mineral acids and molten alkali salts varies with the temperature of formation and ignition. Any titanium dioxide formed below 1300 F is theoretically soluble in concentrated sulfuric acid. As the temperature of ignition approaches 1830 F the solubility in mineral acids and molten salts decreases rapidly. A dioxide formed above 1830 F is theoretically insoluble. Laboratory tests indicate, however, that any scale formed above approximately 1400 F is practically insoluble in most of the common acid and alkali descaling solutions.

Effective Descaling Baths

A survey has revealed that not many solutions are effective in descaling titanium. Among the molten caustic type baths that indicated descaling possibilities and were, therefore, tested in the Laboratory are sodium hydroxide, sodium nitrite, the Virgo salt process and the Kolene No. 4 Process. The acid baths that were investigated are fluoboric, hydrofluoric, nitric-hydrofluoric, hydrochloric-hydrofluoric, and sulfuric acids. Characteristics, advantages and limitations of the various solutions and processes are summarized in Table 2.

The two major characteristics to consider in the final selection of a suitable descaler for titanium are (1) its effect on ductility of the metal, and (2) resulting stock loss.

Some of the descaling methods evaluated effectively remove scale but seriously reduce the ductility of the metal. In addition, some methods that are rapid and effective result in a degree of stock loss that is technically and economically not feasible.

The Kolene No. 4 electrolytic process and the Virgo salt process proved to be the most effective methods of removing tough scale. Light scale can be satisfactorily removed by acid treatment. Some effective descaling procedures that avoid embrittlement and significant stock loss are listed in Table 3. It should be emphasized that there are other molten salt descaling processes that are probably equally suitable for descaling titanium. [*Du Pont's sodium hydride process is one such method, not covered in this investigation, which is being used effectively to descale titanium. There is some belief that the sodium hydride bath tends to adversely affect the ductility of titanium, but nothing conclusive has yet been shown.—The Editors.*] Also, it is possible to overcome the disadvantages of straight acid dips by using sand blasting or other mechanical methods of removing scale prior to chemical processing. For example, titanium oxidized at 1300 F has been cleaned successfully by grit blasting followed by immersion in 8 nitric—2% hydrofluoric acid mixture.

Embrittlement and Stock Loss

Embrittlement caused by a descaling bath was particularly evident with the molten sodium hydroxide

Table 1—Visual Appearance of Scales Formed on Titanium by Heating At Various Temperatures

Temperature, F	Visual Appearance of Surface	Measurable Thickness, In.
600	Straw color	None
800	Purple color	None
1000	Purple faded—darkened	None
1200	Dulled by slight deposit	0.0001–0.0002
1300	Light greenish gray deposit	0.0002
1400	Heavy yellow surface speckled with reddish-brown spots	0.0003
1500	Yellower than above with more reddish brown spots	0.0008–0.001
1600	Solid heavy gray deposit	0.0008–0.001
1700	Heavier gray deposit	0.0016–0.0020

Adapted from "Handbook on Titanium Metal"

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Table 2—Descaling Baths Evaluated

Bath	Characteristics	Advantages	Limitations
Molten Sodium Hydroxide	Descales titanium at temperatures above 700 F by dissolving oxides.	Relative low cost. Availability.	High temperatures necessary for production descaling. At 700 F the descaling rate is very slow, 40 to 80 min being required to remove average oxides. Danger of embrittlement above 850 F. Processing temperatures above 700 F cut descaling time, but ductility is seriously affected. (See Fig. 1). Large stock loss. As processing temperature is raised stock loss increases appreciably.
Electrolytic Molten Sodium Nitrite	Descales titanium without embrittlement when metal is made anode at current density of about 2 amp/sq in. for 3–5 min.	Low operation temperature. No serious stock loss.	Toxic fumes liberated at anode. Shelf life of bath is short. Descaling too slow for production. Large power requirements necessary.
Virgo Salt Process	Essentially a caustic soda bath with about 15% oxidizing agents and additives. Marketed by Hooker Electrochemical Co. and widely used for descaling stainless steel. Descales titanium by dissolving oxides (which differs from its action on stainless).	No indication of embrittlement or loss of ductility for bath temperatures up to 1000 F. (See Fig. 1). Only slight stock loss.	At bath temperatures over 1000 F, titanium reacts violently with the salts, and fire and explosions may result. This is true of all molten salt baths tested.
Kolene No. 4 Process	Caustic type bath. Marketed by Kolene Corp. and used to clean stainless steel and large cast stock. Used both electrolytically and non-electrolytically.	No loss in ductility of metal immersed in either type bath for 30 min at 800 to 1000 F. Electrolytic bath offers speed and lower processing temperatures.	At bath temperatures over 1000 F, titanium reacts violently with the salts, and fire and explosions may result.
Fluoboric Acid	Descales titanium in about 10 min in concentrations of 5% to "concentrated" at 170–200 F. Acid penetrates surface of scale and reacts with metal, flaking off the scale.	No evidence of any embrittlement caused by the bath. Low equipment, installation and operating costs. Etches uniformly.	Large stock loss as high as 8 mils per surface for heavily scaled stock and 4 mils for lightly scaled stock.
Hydrofluoric Acid or Nitric Hydrofluoric Acid	Both HF, in concentrations ranging from 10% to "concentrated", and 8 nitric-2% hydrofluoric acid at 140 F descale titanium by rapidly dissolving the metal beneath the scale.	Effective in short immersion times provided the scale has first been broken. Low equipment, installation and operating costs.	Large stock loss.
Other Acids	Sulfuric acid removes light scales. Mixture of 2 hydrofluoric-3% hydrochloric acid at room temperature reacts in the same manner as nitric-hydrofluoric. Mixture of hydrochloric and hydrofluoric acids effective in removing some types of scale.	Solutions readily available in processing or plating rooms. Same equipment advantages as other acids above.	Irregular attack unless scale is broken.

Table 3—Some Effective Descaling Procedures for Titanium That Avoid Embrittlement and Significant Stock Loss

Light Scale	Heavy Scale Formed Below 1300 F	Heavy Scale Formed Above 1300 F
1. Dip in 15% sulfuric acid at room temperature for 10–15 min.	1. Immerse in Virgo Salts at 800 F for 5–20 min. or Immerse in non-electrolytic Kolene No. 4 bath at 900–950 F for 30 min. or Immerse in electrolytic Kolene No. 4 bath at 825–900 F for 5–10 min.	1. Immerse in Virgo Salts for 20–30 min. at 925 F or Immerse in non-electrolytic Kolene No. 4 bath at 950–1000 F for 30 min. or Immerse in electrolytic Kolene No. 4 bath at 900–950 F for 10–20 min.
2. Water rinse.	2. Quench-rinse in water.	2. Quench-rinse in water.
3. Dip in 3 parts of nitric to 1 part hydrofluoric acid at 140–160 F for 1–3 min.	3. Dip in solution of 10 parts nitric–2 parts hydrofluoric acid and 5 parts water at 140–160 F for 1–2 min.	3. Dip in solution of 10 parts nitric–2 parts hydrofluoric acid and 5 parts water at 140–160 F for 2–3 min.
4. Water rinse.	4. Water rinse or	4. Water rinse or
	3a. Dip in concentrated hydrofluoric acid for 10–15 sec.	3a. Dip in concentrated hydrofluoric acid for 30–60 sec.
	4a. Water rinse.	4a. Water rinse.

bath. The loss in ductility of commercially pure titanium treated in the temperature range of 850 to 1000 F, is shown in Fig. 1 where performance is compared with that of the Virgo salt bath. At 1000 F, titanium can be thoroughly descaled in 1 min, but its ductility drops from an angle of bend of 180 deg to one of about 30 deg. Such losses would be prohibitive from the standpoint of both application and fabrication. In the Virgo bath (and the Kolene bath which behaves similarly) no loss of ductility occurred in titanium processed for 30 min between 800 and 1000 F.

The attack on titanium by the various solutions is important in the processing of the metal. Some processes which will descale titanium are much too drastic for production use. The stock losses experienced

Fig. 1—Graph shows the effect of immersion in ordinary caustic soda and in the Virgo Salt bath on the ductility of titanium. Results for the Kolene No. 4 bath were similar to those for the Virgo process.

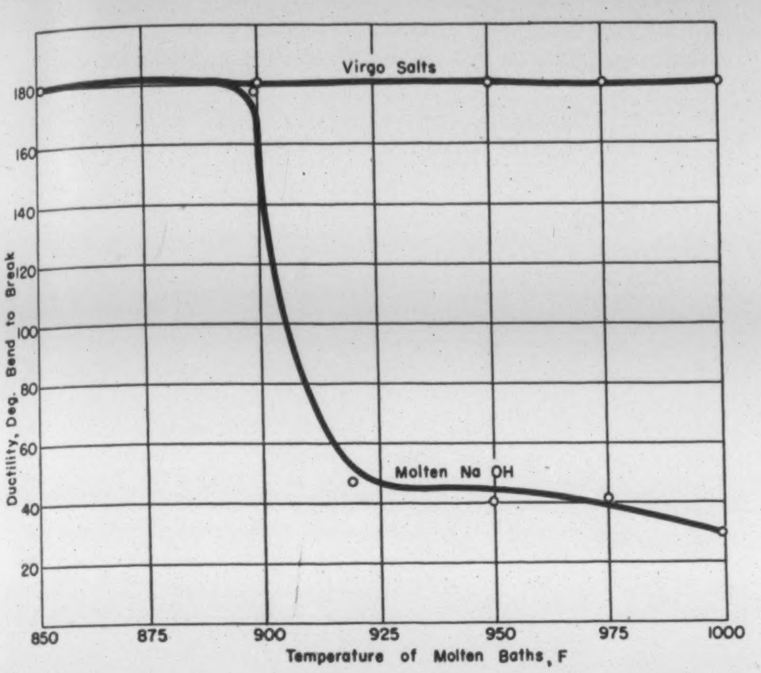
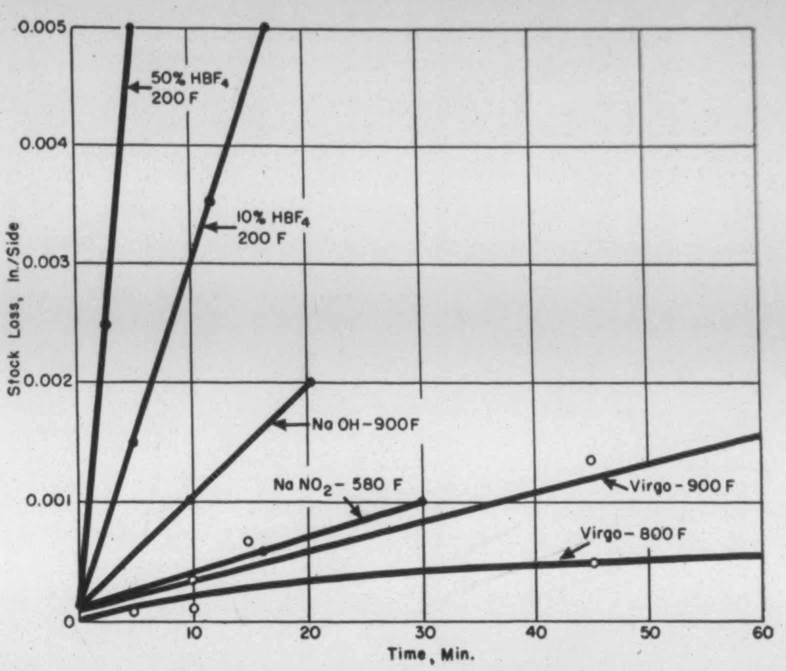


Fig. 2—Stock losses caused by various descaling processes for titanium are shown here.



with the different descaling methods are compared in Fig. 2. Metal immersed in a fluoboric acid solution loses from 1.5 to 5 mils per side in 5 min, whereas the Virgo salts at 800 F attack the metal only slightly, less than 0.75 mils of stock being removed in 2 hr at this temperature. At 900 F for the same time, 3 mils is removed. Figures for Kolene-treated metal are not included here but compare favorably with the Virgo values.

Acknowledgment

The author wishes to acknowledge the assistance of W. S. Farrell of the General Electric Chemical and Metallurgical Program in this work.

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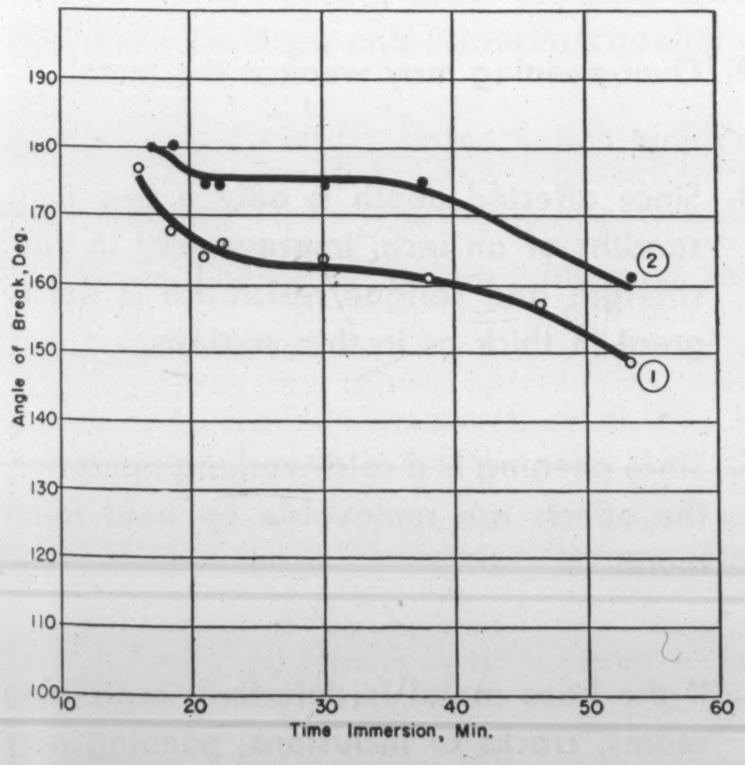
Embrittlement of Titanium

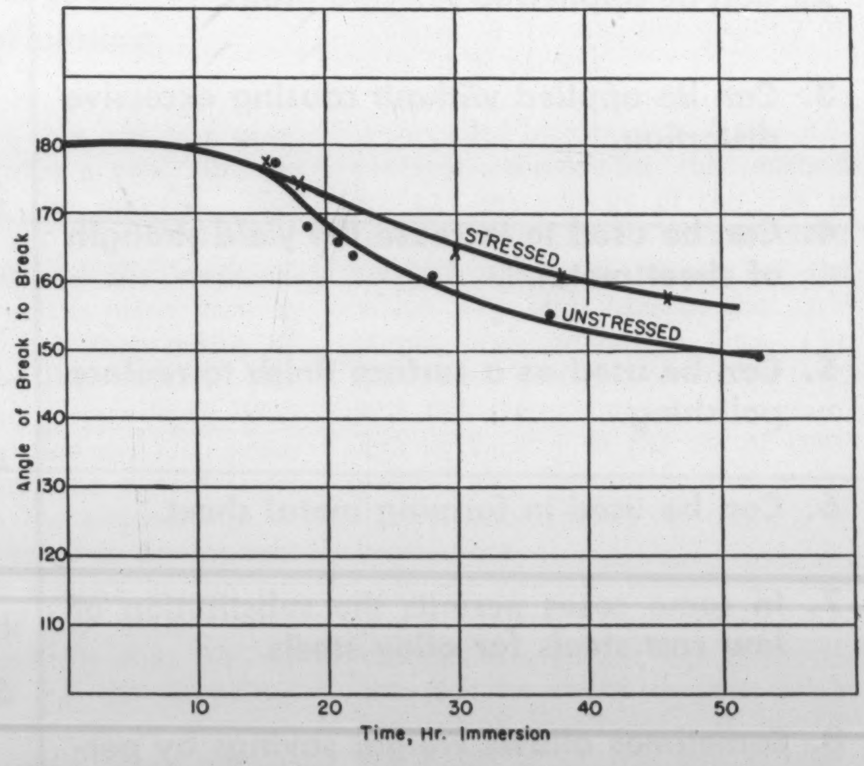
In connection with the descaling of titanium, the effects of hydrogen and stress on the ductility of the metal were investigated. Changes in ductility were measured on a constant rate bend machine.

The results of tests on commercially pure titanium, which had been oxidized at 1300 F for 30 min, and immersed in a 10% electrolytic caustic solution are shown in the accompanying graph. Minor embrittlement is apparent but it is not as serious as in some common steels. As indicated, heating the metal in water at 200 F increased ductility of the parts by 7 to 15 deg, indicating the embrittlement was only minor.

Similar tests were conducted with the parts subject to 68,000 psi stress to determine their susceptibility to stress corrosion. The angle of break was determined at the point of maximum deflection and certain distances away from this point. The similarity of the curves for the stressed and unstressed parts in the graph indicates that the loss of ductility in titanium can be attributed to hydrogen embrittlement and not to stress corrosion as such.



Embrittlement of titanium caused by immersion in a 10% electrolytic caustic solution. Curve 1 represents samples from bath. Curve 2 shows results of heating these treated samples in water at 200 F.



Effect of stress and hydrogen on titanium. Upper curve represents samples stressed at 68,000 psi during treatment in electrolytic caustic bath.

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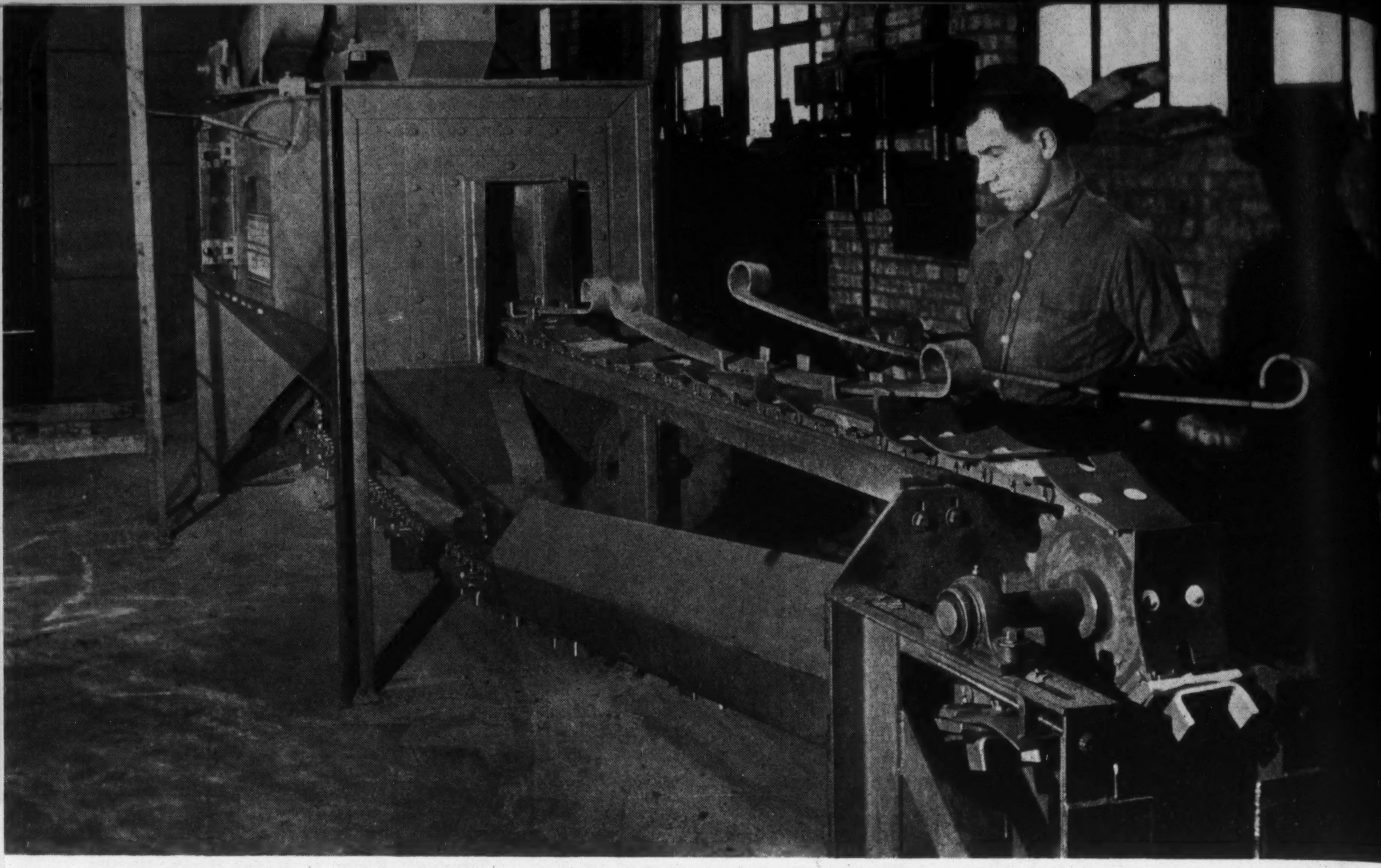


FATIGUE LIFE of trailer springs is greatly extended by shot peening to develop compressive stresses in the outer layers.

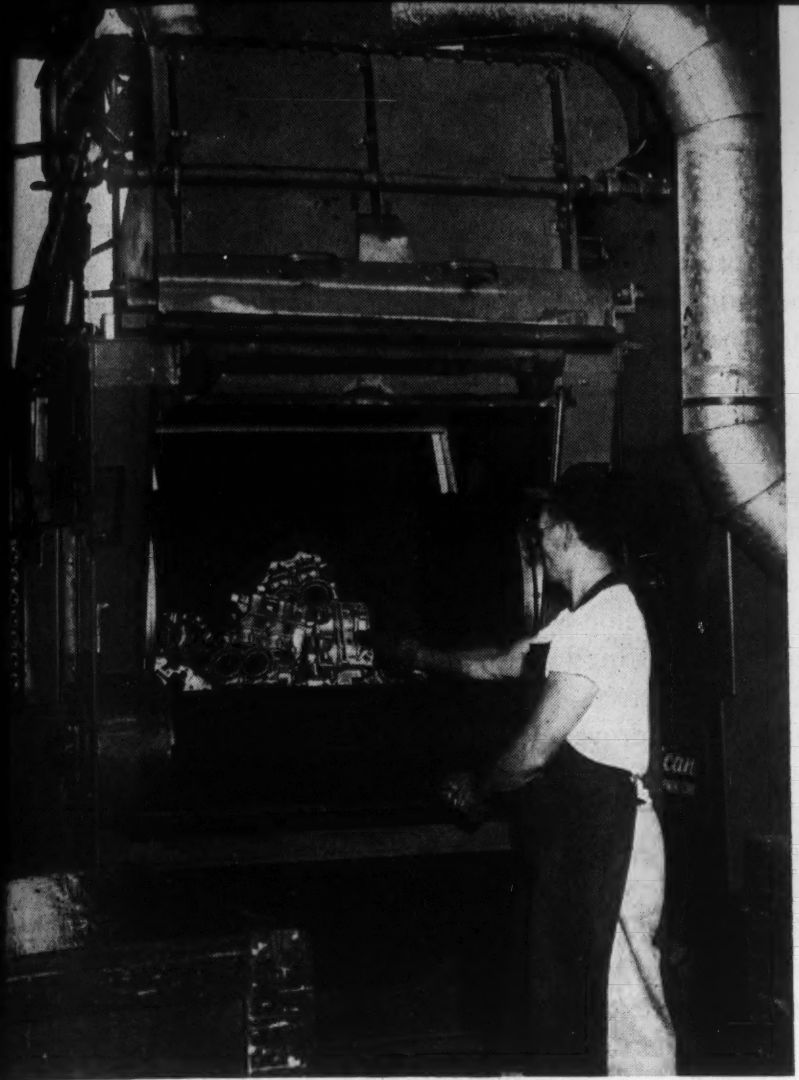
Where Shot Peening

Advantages

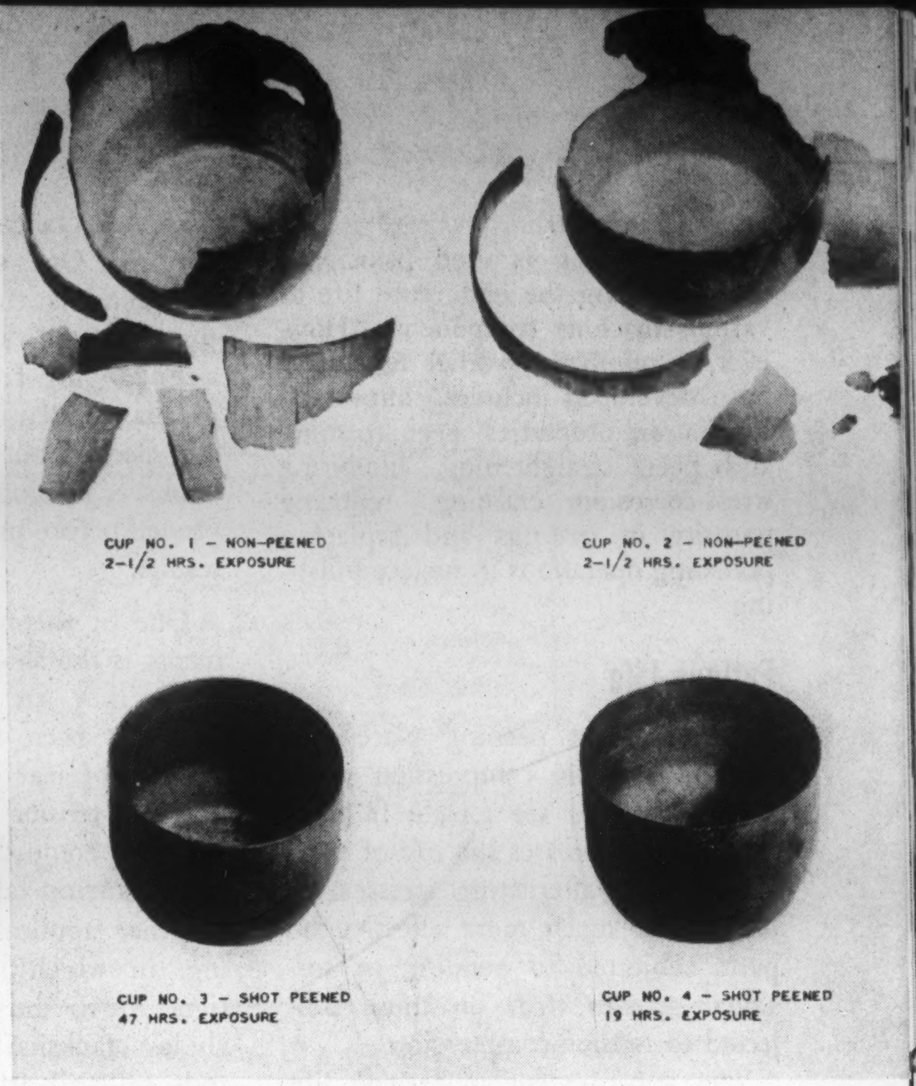
1. Can be applied to finished parts.
2. Can be applied to selected areas.
3. Can be applied without causing excessive distortion.
4. Can be used to increase the yield strength of sheet metal.
5. Can be used as a surface finish to replace polishing.
6. Can be used in forming metal sheet.
7. In some cases permits the substitution of low cost steels for alloy steels.
8. Sometimes allows weight savings by permitting the use of higher stress levels.

Limitations

1. Not very effective in increasing fatigue resistance to tension-compression loading.
2. Over-peening may weaken the metal.
3. Since affected depth is only a few thousandths of an inch, improvement in yield strength and fatigue resistance is not so great in thick as in thin sections.
4. Since peening is a cold-working operation, the effects are removable by heat treatment.
5. If the base metal is defective, containing seams, cracks or inclusions, peening may not be effective.



POROUS ALUMINUM DIE CASTINGS for outboard motors are salvaged and at least 40% of "leakers" pass a water test after shot peening.



STRESS CORROSION CRACKING of cold drawn brass in an ammonia atmosphere is retarded by peening.

Can Be Used to Advantage

by **JOHN L. EVERHART**, Associate Editor, Materials & Methods

First developed to improve fatigue life of springs, the use of shot peening has expanded to include (1) straightening and forming, (2) decreasing stress corrosion cracking, (3) reducing porosity in castings, and (4) testing quality of plating.

• PROBABLY THE EARLIEST method of cold-working, peening has been used for centuries by blacksmiths to improve the properties of a metal. In recent years the method has been industrialized by transferring the peening operation from the hammer to the hammering effect obtained by hurling shot at high velocity against a metal surface. This operation, well known as shot peening, is now employed to improve the properties of the surface and is particularly effective in increasing fatigue life.

Shot peening is accomplished either by centrifugal force or by air blast. Shot of a selected size and hardness is hurled at controlled velocity and direction against the surface of the work to be peened. Each particle of shot acts as a peen hammer and makes a small dent in the surface of the material. The surface layers are stretched beyond the yield point and the result of many such impacts is plastic flow to a depth of a few thousandths of an inch below the surface. The metal below this surface layer, however, is not stretched and after peening, acts to force the surface layers to conform to the original size of the part. The result is development of compressive stresses in the surface layers. If the section being peened is sufficiently thin, the restraining force of the un-peened metal is not sufficient to overcome these compressive forces and warping occurs. This effect is used to advantage in the Almen gage for determining the intensity of shot peening and also in peen-forming.

Selection of the method of peening depends on the application, particularly on the size and quantity of parts to be peened.

In the centrifugal method, the shot is propelled by a bladed wheel. Advantages claimed for this method are (1) the velocity of the shot is readily controlled by maintaining a constant speed of rotation of the wheel, (2) high rates of shot flow permit high production rates, (3) the wheel is a self-contained unit, and (4) there is no moisture problem as there is in the use of compressed air. Peening by this procedure is employed for the majority of applications.

In the air-blast method, the shot is propelled by compressed air. Advantages claimed for this procedure are (1) the ability to peen inside surfaces of deep holes, (2) suitable for limited production, and (3) useful for peening of a small area on

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an intricate part.

Shot peening is used principally for improving the endurance life of various machine components. However, a number of other uses have been developed including improving lubrication properties, peen forming and peen straightening, inhibiting stress-corrosion cracking, reducing porosity in castings and replacing polishing operations in surface finishing.

Fatigue Life

Because shot peening places the surface layers in compression while fatigue failures are tensile failures, the process increases the life of parts subjected to alternating stresses. It is however much more effective on parts subjected to bending or torsional stresses than on those subjected to tension-compression.

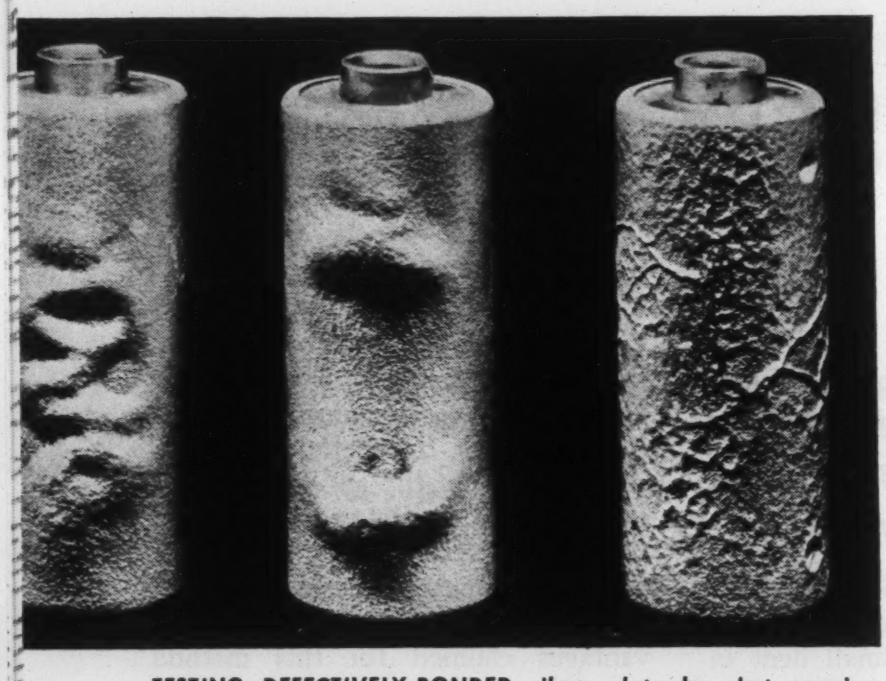
The improvement in fatigue life was first taken advantage of for springs. One of the principal applications is the peening of compression coil springs having wire sizes ranging from 1/16 to 2½ in. in dia. Extension coil springs are also peened but usually only on the hooks. Torsion leaf springs are peened before pre-setting for the best results.

One of the more recent developments is the shot peening of springs while they are held under stress. This has been reported to improve the life of leaf springs peened only on the tension side and of coil springs. Some data are given in an accompanying table.

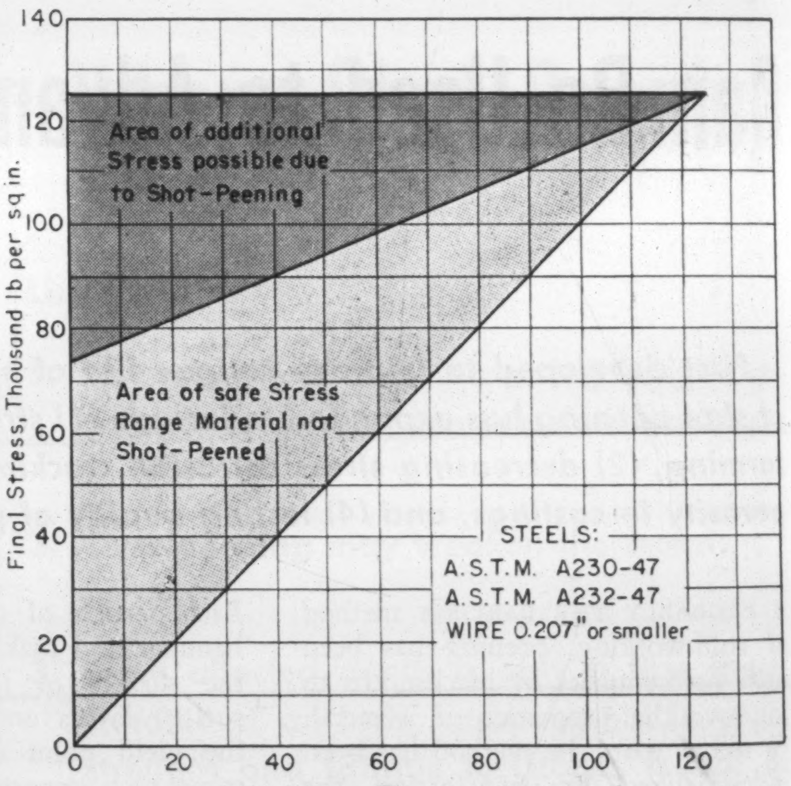
Other applications of shot peening, in which improvement in fatigue life is the major objective, include crankshafts and connecting rods, oil well drill pipe, sucker rods, mandrels, and gear teeth. An additional feature observed on shot-peened gear teeth is an improvement in lubricating properties. This has been attributed to retention of oil depressions formed by peening.

Peen Forming and Straightening

As mentioned previously, compressive stresses set up by peening a surface cause curvature in thin sections. This phenomenon is employed in the peen forming of aircraft wing panels. These panels are produced by machining the skin and stiffening members from a single 75ST6 aluminum alloy plate. In making this integrally stiffened wing section about 80 to 95% of the original stock is removed leaving a flat panel which requires curving to meet aerodynamic requirements. These wing sections range up to 32 ft long by



TESTING DEFECTIVELY-BONDED *silver plate by shot peening. The hammering action of the shot deforms the silver. If the bond to the steel-backing is poor, blistering occurs.*



Shot peening of pretempered wire increases the range of permissible stress (Associated Spring Corp.)

"PEEN FORMING" is used to develop the small curvature necessary to fit this wing skin to the wing structure.

46 in. wide and offer a major problem in final forming.

By trial and error methods, the proper peening intensities were developed to enable a skilled operator to form the part in a single pass through the shot peening machine. The radius of curvature specified at the inboard end was 300 in. At the outboard end it was 180 in. It was found also that parts over-peened and thus curved beyond the specified requirements could be peened on the opposite surface to reduce the curvature to the desired value.

A major simplification in manufacturing methods resulted from the development of this forming method. The application of peen forming eliminated the fabrication of 1500 separate parts and the use of 5000 rivets in a 32-ft wing section.

Since the shape of relatively thin parts can be changed by shot peening, it is possible to straighten warped parts by this procedure. Selective peening is used to straighten shafts and tubes and to round-out rings and ring gears. Carburized ring gears 48 in. in dia have been rounded to within 0.003 in. by this method.

Stress Corrosion Cracking

Spontaneous cracking which occurs in some metals under the combined effects of high stress and corrosive attack occurs in the region of the part which is stressed in tension. Experimental work has indicated that shot peening, by imposing a surface layer under compression, can be useful in increasing the life of some of these materials. The tests have indicated that the life of certain magnesium alloys, cold drawn brass and stainless steel can be increased considerably under test conditions which cause rapid deterioration of the unpeened parts.

Other Applications

Shot peening has been used to overcome slight porosity in aluminum die castings. Apparently sufficient flow of metal occurs during the peening operation to close the pores. Of course, this effect will be lost if the peened surface is removed by subsequent machining.

Effect of Shot Peening on Fatigue Life

Part	Life (cycles)		
	Unpeened	Shot Peened	Shot Peened Under Static Stress of 137,000 Psi
Axle Shafts	75,000	379,000	—
Axle Shafts	250,000	5,000,000*	—
Ring Gear and Pinion	150,000	350,000	—
Leaf Springs	300,000	700,000	—
Steering Knuckles	520,000	2,200,000	—
Sway Bars	140,000	475,000*	—
Armasteel Test Bars	150,000	5,000,000*	—
Spring Steel	55,000	275,000	7,264,000
Spring Steel	25,000	117,000	4,200,000

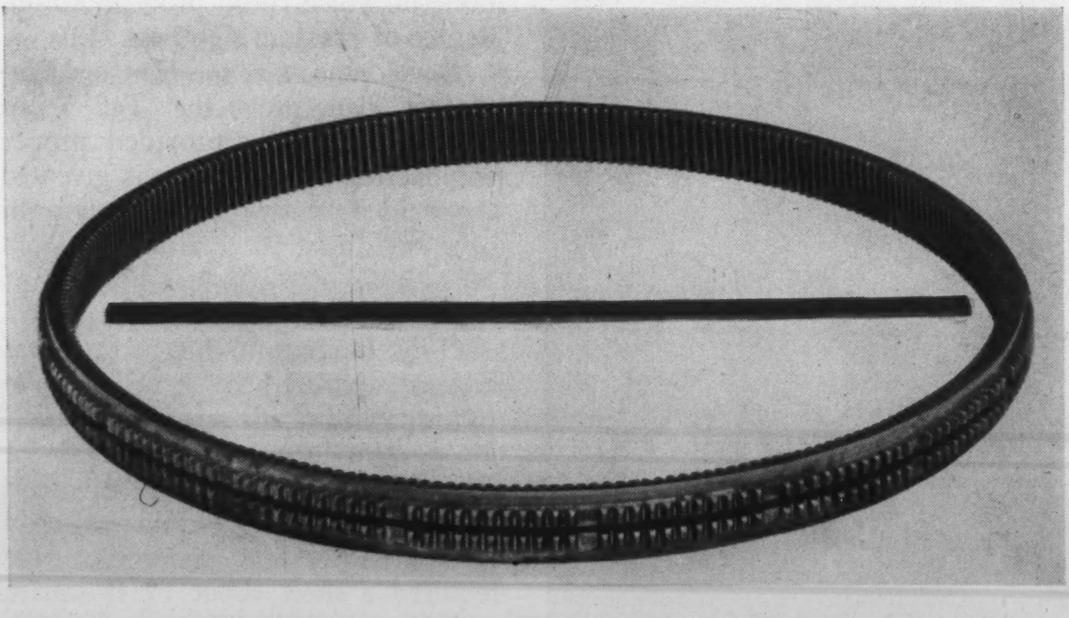
* *No failure.*

(*American Wheelabrator & Equipment Corp.*)

The process has been used also as a surface finishing method to replace the polishing of connecting rods with savings reported to range up to 40 man-hr per engine.

The quality of the bond obtained when steel is silver plated can be determined by shot peening. A testing method has been developed which relates peening intensity to adherence. It is in use for determining the quality of plating on silver-plated steel bearings for aircraft.

Shot peening is also under investigation for improving the properties of isothermally quenched steels. The steel is quenched from above its transformation temperature into a molten bath held above the martensite formation range and removed before transformation of the austenite is complete. The desired surface is shot peened while the steel is hot and the part is then cooled to room temperature. It is stated that greater compressive stresses are set-up in the surface peened in this manner than in that peened conventionally and fatigue resistance is improved.



SELECTIVE SHOT PEENING *was used to round this ring gear to within 0.0015 in. Gear is over 3 ft in dia.*

PICTURE CREDITS: American Wheelabrator & Equipment Corp., Associated Spring Corp., Lockheed Aircraft Corp., and Metal Improvement Co.

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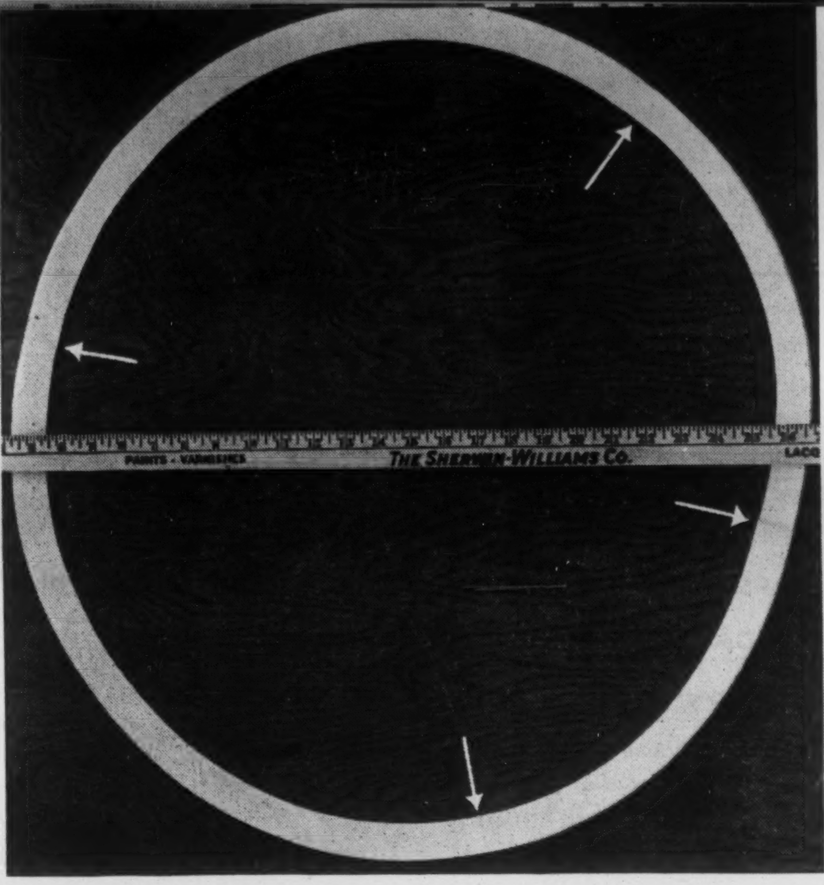


A large gasket made up of four integral pieces of Teflon, butt welded at the points marked with arrows.

Teflon Joined by Fusion Bonding

by H. G. HENRY, Process Engineer, General Electric Co., Hanford Atomic Products Operation

With the proper combination of temperature, pressure and time, this difficult-to-join material can be readily welded.

● THE JOINING OF TEFLON to itself has been a problem ever since its development during World War II. A chemically inert polytetrafluoroethylene resin, it does not flow at ordinary molding temperatures, though it does become a gel at its melting point and can be handled as a semi-solid of extremely high viscosity. In the past, the only practical means of joining seemed to be by mechanical methods, none of which could produce a high degree of pressure tightness.

Developments at the Hanford Plutonium Plant prove that Teflon can be welded readily provided proper engineering consideration is given to the welded joint. The tensile strength of the resulting bond will range from 30 to 70% of the tensile strength of the parent material.

G-E's interest in this process was aroused when it became necessary to fabricate and repair several large Teflon gaskets during the installation of chemical apparatus at the Hanford Plant. To fashion the gaskets directly from an integral piece would have required a sheet about 17 ft square and 1/8 in. thick. The cost of this amount of Teflon would have been around $45,000, with delivery date estimates ranging from four to six months. Due to the urgency of the installation and the need for adequate repair or replacement, it was necessary to devise some other method of making the gaskets. It was estimated that if five constituent gaskets were cut out of smaller sheets and could be joined together to form one large one, a 50% reduction of material could be realized.

After inquiries failed to reveal any developments in the welding of this material, mechanical joining methods were thoroughly investigated. Mastic compounds and rubber molding methods were unsuccessful; pegged, tongue and groove and sandwich joints, though displaying fair mechanical qualities, lacked positive pressure tightness. In this case pressure tightness was very important as the vessels would contain quantities of radio-active solutions which if spilled, would result in serious operational and health hazards.

Temperature, Pressure and Time

With the elimination of the possibilities of mechanical joining, it was decided to experiment with welding or fusion bonding methods. Utilizing the data compiled from the manufacturer of the resin and from published literature, it was found that the material decomposed slowly from its solid phase at about 620 F with a sharp drop in strength. Yielding first the gaseous monomer, it gives off other gaseous chlorine derivatives at around 750 F. It was also found that since minute amounts of gases containing fluorine escape at temperatures as low as 420 F, adequate ventilation was necessary in all areas where the experimental work was done.

When the temperature limits of the material had been determined, it was necessary to find the proper pressure and time combinations that would result in the effective joining of the material to itself. In the ensuing furnace tests, three types of joints were used: the butt joint, tongue and groove joint, and the joining of two sheets face to face. In all cases it was found desirable to clean and degrease the joints prior to welding. The best results were obtained with the tongue and groove and the face-to-face joints which were bonded in the furnace at 660 F for 48 hr. In all cases bonding and/or welding was very good to ex-

Two strips of Teflon, lap welded, produce a joint the tensile strength of which is 30 to 70% of that of the parent material.

cellent, the surfaces across the interface appearing homogeneous, and subsequent tests showing that the material had not been appreciably affected either chemically or physically by the bonding process.

Primarily, these initial tests were used to determine the feasibility of the bonding scheme. Further work was then done in the formation of thick materials by laminating 1/16 and 1/8 in. pieces. One of the inherent difficulties in the process was that it was necessary to maintain the bonding temperature at all faces where bonding was desired, and in no instances were welds evident, no matter what pressures were applied, where this temperture was not maintained.

The results of these tests and other work on the process disclosed that bonding conditions are generally characterized by transformation of the Teflon from the white opaque substance to a translucent gel, which is maintained from about 620 to 750 F at which point the material starts to decompose rapidly. The optimum temperature for bonding was found to be 660 F ± 10 F, and the time required, 4 to 48 hr. Optimum pressures were found to be around 75 psi. These pressures were so low that normally, the material was confined to the required thickness and its thermal expansion furnished the necessary pressure at the bonding interface.

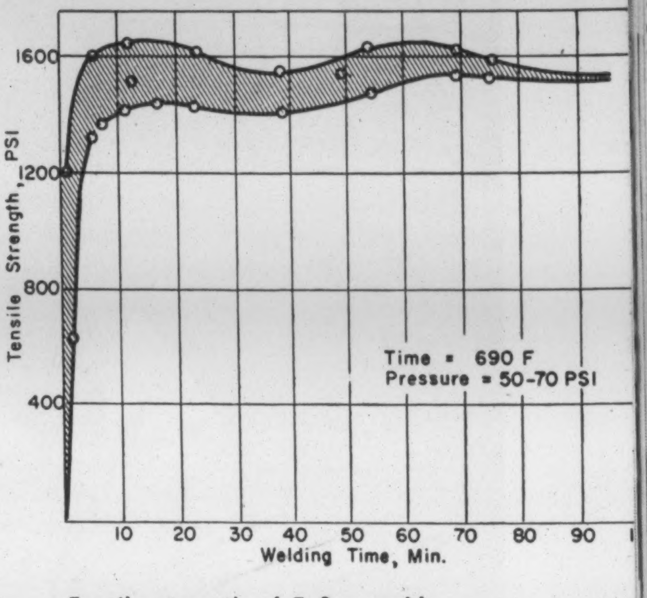
Variations of Technique

Subsequent work by Atkinson & Jones Construction Co., a Hanford subcontractor, further developed the welding technique, making it adaptable to field fabrication or repair of large diameter gaskets. It was found that the time element is, to some extent, a function of the method by which the heat is applied, as it is absolutely necessary to maintain the bonding temperature at the welding interface. Therefore, by applying localized heat to the joint by means of a current-carrying grid, sandwiched between the areas to be joined, the welding time was materially reduced. A clamp was devised and after experimenting with various heating grids, it was found that good welds could be made with the greatest strength being developed in 7 to 9 min. Maximum pressures applicable in the 620 to 690 F range were found to be between 45 and 70 psi depending on temperature, extent of heated zone, manner in which pressure was applied, and freedom of the material to extrude.

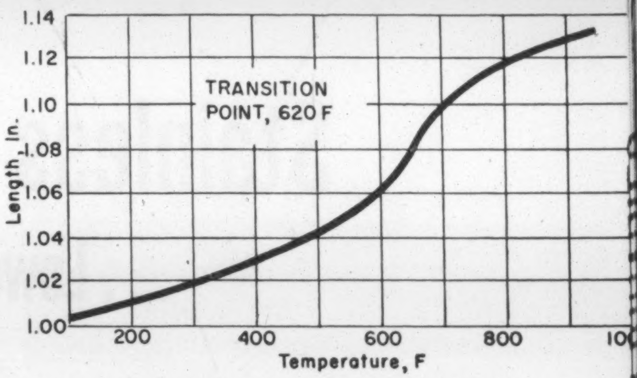
Another approach employed a small plaster of Paris or transite welding furnace with a mica lining around which was wound #38 Nichrome wire. Welds made by butting Teflon together in this device proved to be consistently higher in tensile strength due to the absence of discontinuities in the joint. Discontinuities in a weld apparently act as stress raisers and affect the overall strength of the bond.

Applications

At Hanford, the majority of applications for these welding techniques, which can be disclosed at this time, are in fabricating large diameter gaskets and "0"-rings. Work is now under way to fabricate "0"-rings directly from Teflon rods by welding the ends together, which should prove ideal for field fabrication and maintenance of expensive gaskets and "0"-ring seals.



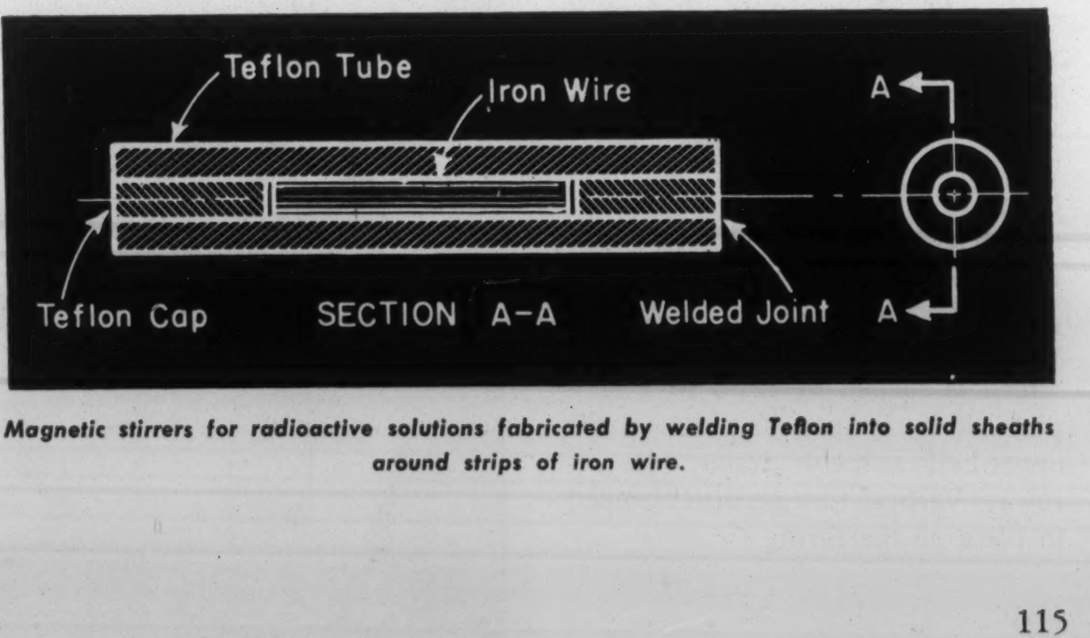
Tensile strength of Teflon welds.



Linear expansion of Teflon. Total length versus temperature.

Another unique application is for magnetic stirrers used in laboratory research on plutonium. Since it is not possible, due to the toxicity and radiation hazards, to directly stir even small quantities of this material in liquid form, a rotating magnet is installed below the plutonium vessel. At first a glass-encased soft iron wire was rotated in the induced magnetic field to stir the solution. However, occasionally the glass case would break, allowing the iron to contaminate the entire plutonium solution. Teflon was then suggested since it will not break and is impervious to corrosion. A 1/8 in. o.d. Teflon tube with a 0.035 in. i.d. was fabricated and a short piece of soft iron wire placed in the center. Teflon plugs were then inserted in each end, a suitable heating mold was produced, and the material was fused at 660 F for several hours, forming a solid plastic sheath around the wire. The stirrers have currently been in use for well over a year and the Teflon casement shows no visible signs of chemical attack.

Plans are currently being made to utilize this resin in the fabrication of small plastic ionization chambers which must be hollow and contain no metal in order to give the desired result. With the development of this welding process, Teflon, which is the only plastic dielectric with both the electrical and corrosion-resistant properties necessary for this job, should prove to be the ideal material.



Magnetic stirrers for radioactive solutions fabricated by welding Teflon into solid sheaths around strips of iron wire.

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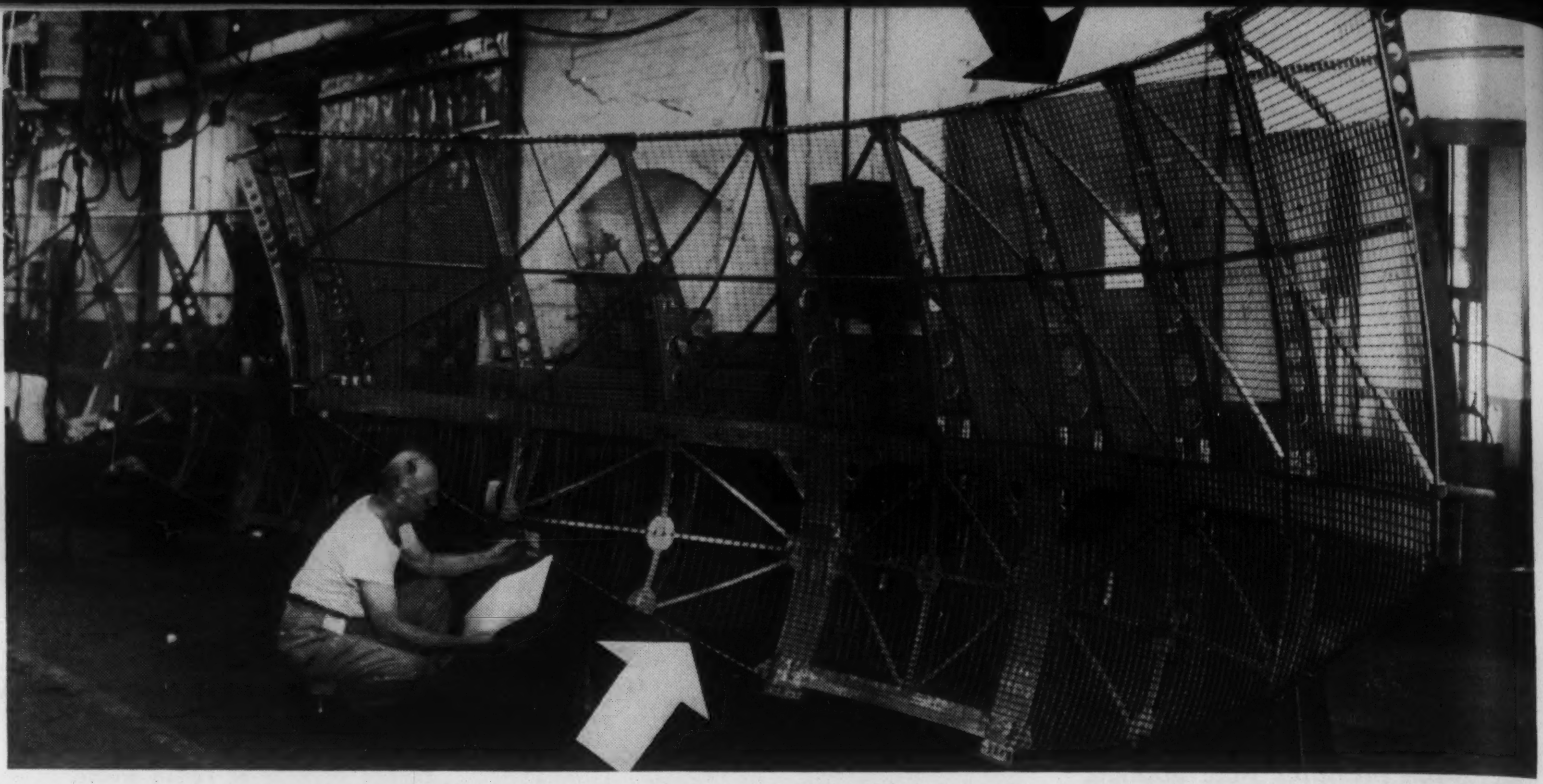


Finished radar screen features unusual structural design. Tubular spanning members (arrows) form top and bottom edges of the parabolic screen.

Stainless Tubing in Radar Screens...

...Lowers Cost ...Simplifies Fabrication

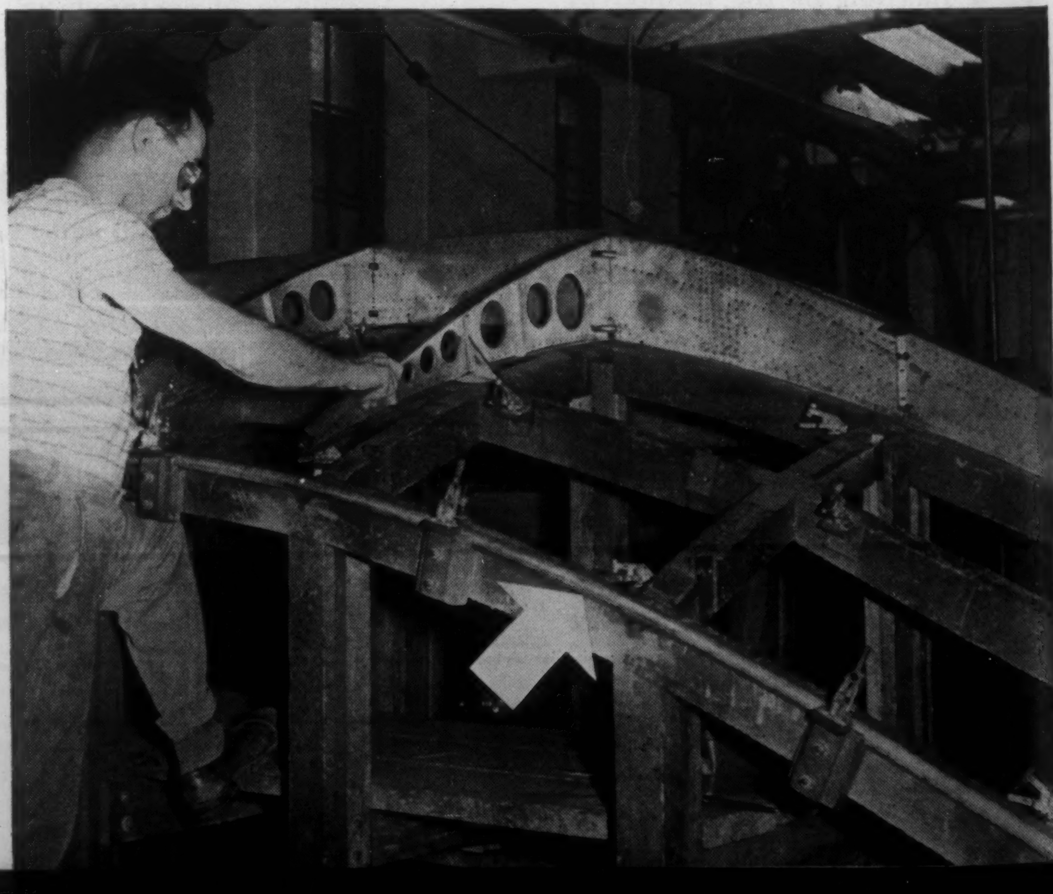
The requirements that must be met by radar scanning screens for naval vessels include: (1) strength to resist the winds, vibrations and pitching and tossing movements (2) light weight and (3) accurate shape which must be retained to preserve the operating characteristics of the radar. To achieve these, engineers of ITE Circuit Breaker Co. departed from the usual design approach of forming the screen's supporting frame entirely of girder sections. Instead they formed the frame of vertical ribs, but connected these by tubular spanning members across the top and bottom.

In consultation with the technical staff of Superior Tube Co., the ITE engineers selected stainless steel tubing type AISI 304. For the top spanning member, 1.0-in. o.d. size tubing was adopted. For the lower member of the parabolic frame, 0.50-in. size was used. By taking advantage of the bending and welding properties of this tubing, a relatively simple fabricating procedure was developed. Net result of this new structural design and new fabricating technique is a radar screen of the required lightness, strength and shape, but produced faster, at lower cost, with less use of skilled labor and with less consumption of strategic materials than were formerly needed.

A step-by-step explanation of this new fabricating procedure is given in the following illustrations.

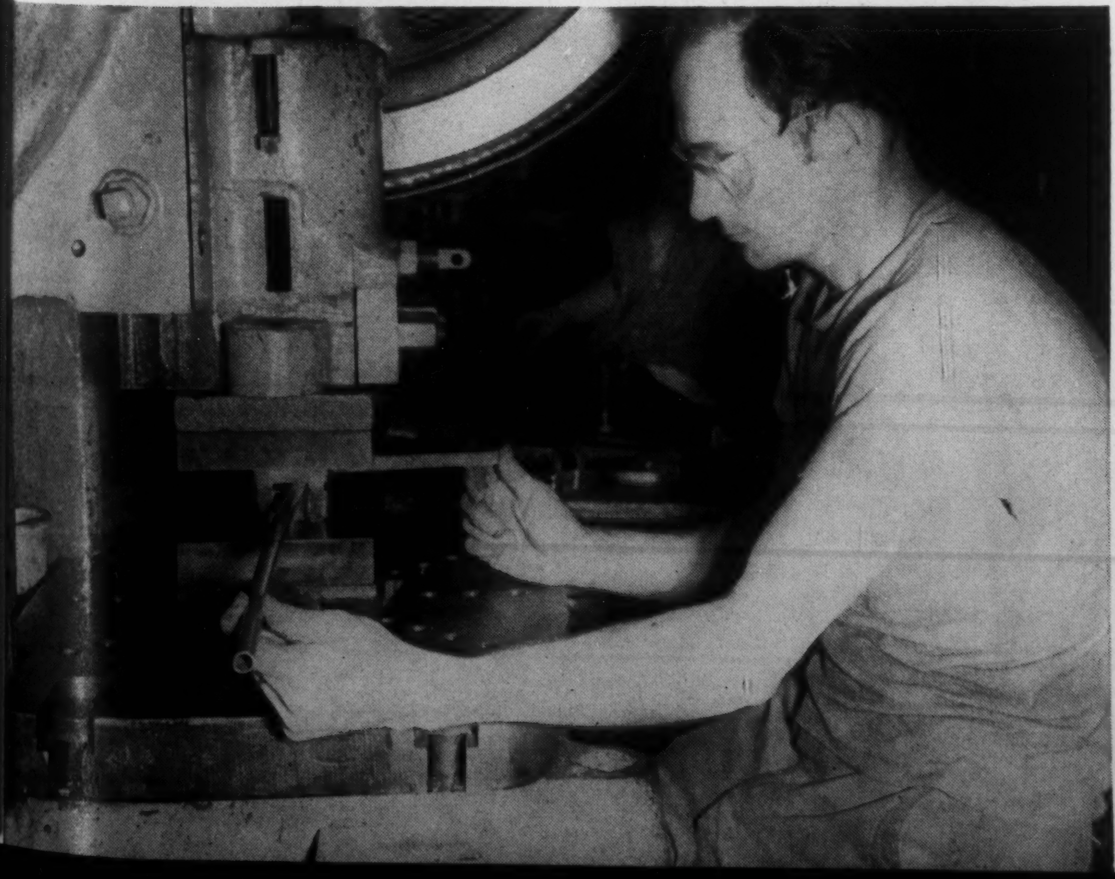
---

1 Tube bending method developed avoids the usual mandrel techniques. Desired parabolic curve is obtained by bending the long top edge tubing sections to conformity with a template. Three men accomplish the shaping of these sections without using mandrels inside the tubing, and without creating distortions in tubing cross section. The upper half of the screen's skeleton is built on a wooden shaping form. After the single length of tubing which forms the top edge of the screen is shaped by hand to a template, it is clamped in place on the upper-half assembly frame (see arrow). Vertical ribs are also clamped in place on the form.



2 Vertical ribs and tube are welded together. Cantilever action of the assembled tubing adds considerable rigidity to the skeleton. Tubing ends are plug welded to corner braces, electric shot welded to vertical ribs. Bracing provides the extra joint strength necessary for tube rigidity.

3 The shorter half-inch tubing lengths are given the required parabolic shape by several passes through special shaping rolls. The stainless tubing, cut to the right lengths, is passed through the cold rolls without a mandrel. Each time the tube passes between rollers, the degree of arc is increased. The gentle pressure of the rolls does not distort tube cross sectional roundness even when this forming pressure is continued.



4 After the lower-edge tubing has been shaped to the right curvature, a hydraulic press flattens the structural tubing for easy joining to radar screen rib ends. Rapid and uniform pressure of the press insures a perfectly flat joining surface at the precise point of contact without: (1) affecting the tube's parabolic shape, (2) distorting the cross sections along spans where rigidity is specified, or (3) unduly stressing the metal at flattened areas.

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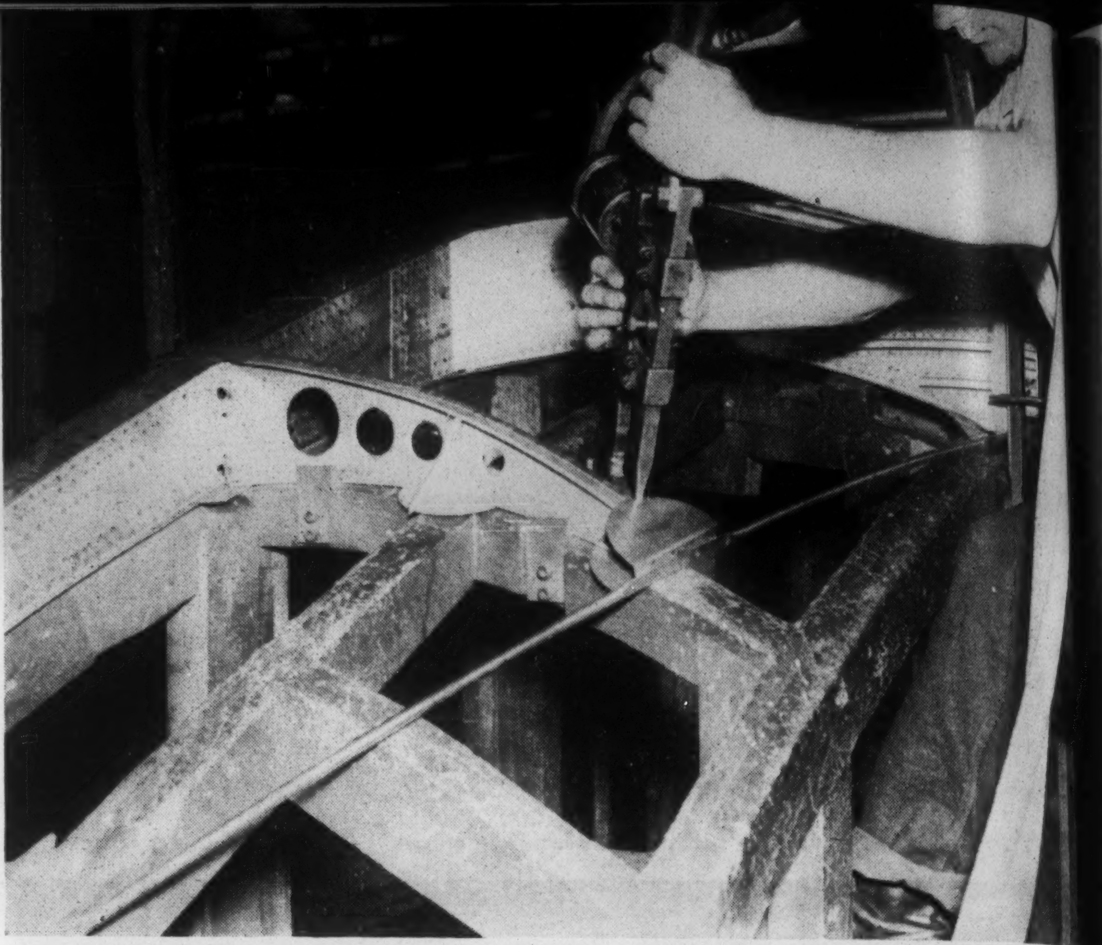
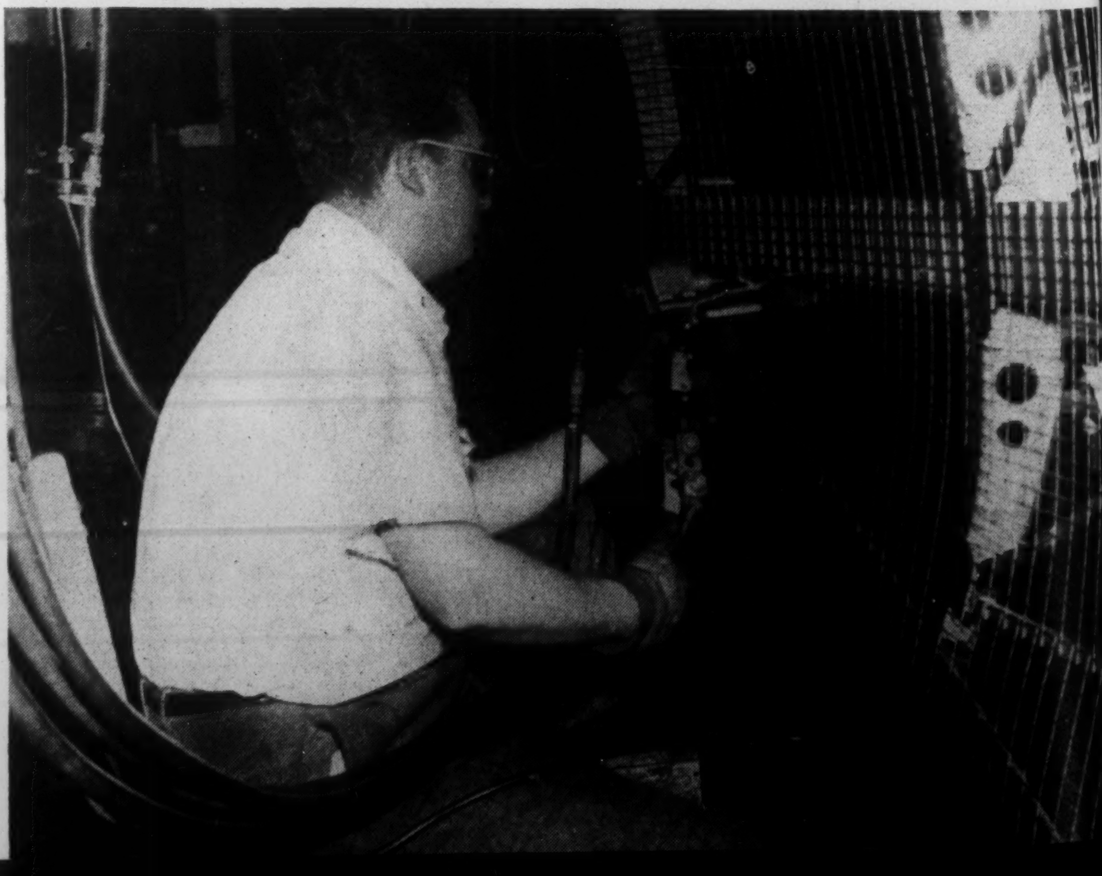
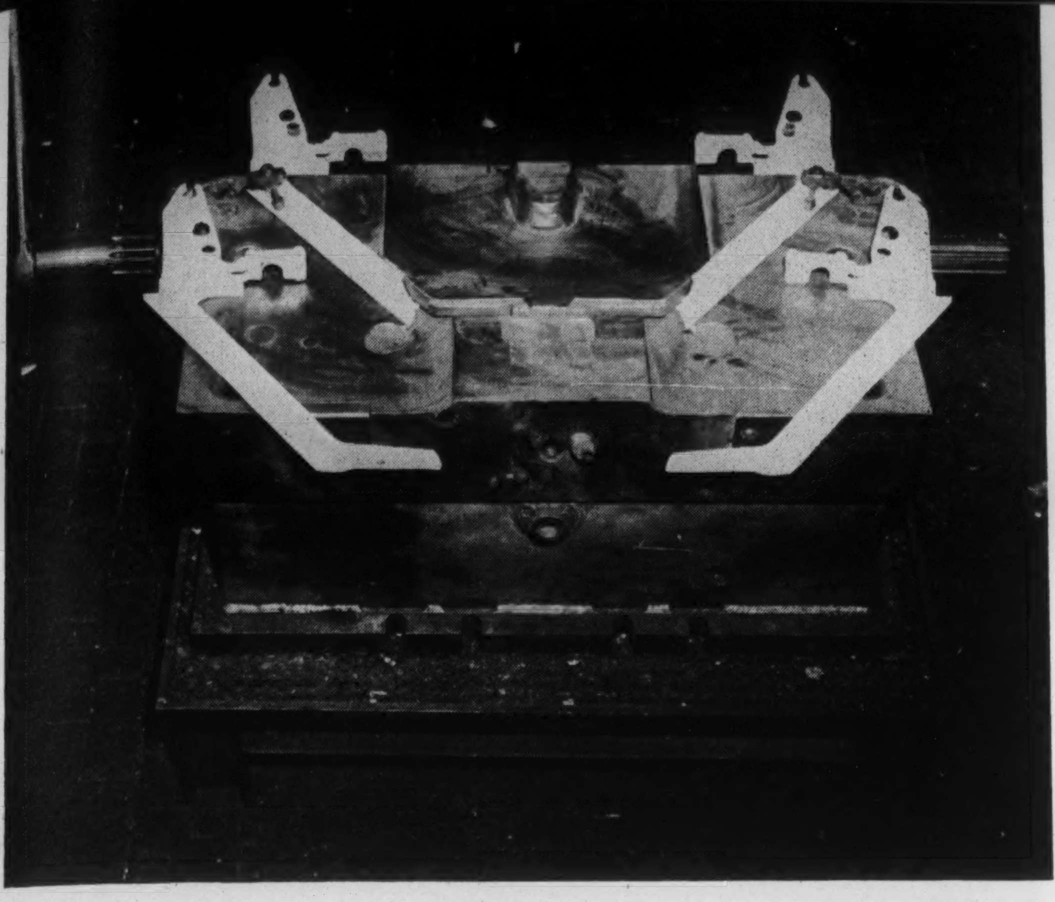
5 The pre-shaped tubing members are then electric shot welded to stainless joint flanges—which in turn are shot welded to the bottom ends of radar screens vertical ribs. Assembly of the screen's rigid skeleton is done on specially constructed wooden forms. Welders reach spots to be tacked with electric hand welding machines which are suspended for ceiling on track carriages.



6 Final joining of half-inch tube members to the radar screen frame is accomplished by shot welding of the tacked joints. Lower assembly of the screen skeleton has been removed from wood shaping form, is now ready to be joined to upper assembly.

7 Stainless steel wire screening is hot welded to the assembled radar screen frame. After top and bottom edges are welded on face of screen, excess screening is clipped one inch beyond tubing, rolled over and tacked along reverse side. For greater structural strength along the edges of the parabolic radar screen, inert arc welding is used.





One pair of standard "CV" frame castings (bottom) and one pair which have been trimmed for fuse casting of new configuration on end of frames (top).

Problem: *To obtain limited quantities of special shapes at low cost.*

A Solution: Fused Die Castings

by **HERBERT CHASE**

● THE DEVELOPMENT OF a new casting technique promises to eliminate the need for many expensive new dies where the desired shape of the new part is similar to a standard casting already in production. Among the zinc alloy castings manufactured by the Ternstedt Div. of General Motors Corp. for car window frames and ventilating panes, similar, though not identical, castings are required in limited quantity for use on their sport car models. The cost of a complete new die would be prohibitive for such limited production. However, it was found that by constructing a die, the cavity of which would form the new shape on the end of the main casting, revised shapes and dimensions could be fuse-cast to the standard part at approximately one quarter of the cost of a new die.

One example of the use to which this process has been adapted at Ternstedt is the modification of the so-called "CV" frames that support a shorter than standard ventilating plate on a special sport car model. This altered casting is required in limited quantity which would not justify the fabrication of a new die at an approximate cost of $25,000.

By altering the standard die to make the fused casting, the cost was reduced to approximately $6,000. The standard die is used regularly for making frames in high production quantities, but about once a month the cavity is changed to produce a run of several hundred of the special fused castings, after which the die is reconverted for use in standard production.

The equipment needed for this process is an induction heater and a die, which is constructed to form the revised dimensions, with apertures to hold the cut-off ends of the standard casting. About four inches of these cut-off ends are first brought to a temperature of about 400 to 420 F in the heater before inserting in the die. This allows the end of the casting to fuse solidly with the molten zinc alloy in the casting die. Gating in the die is such that the zinc alloy injected into the new cavity flows across and melts part of the hot, cut-off end of the inserted casting, fusing with it before the newly cast portion freezes in the die.

Results have proved completely successful at Ternstedt. The new zinc alloy casting proves to be a little stronger at the point of fusion than the standard casting at the same section, where sectional area is equal. No thickening at the point of fusion is necessary and except for slight marks on the casting where the new cavity blocks join the old, the section appears as though cast in one piece.

When the altered die is in use, the induction heater, which is kept adjacent to the die casting machine, is loaded by the operator while the casting machine runs through its normal automatic cycle. Heating one end of the cut-off "CV" frame casting requires about 26 sec, and by the time this insert is up to the required temperature, the casting machine has opened and has been unloaded by the operator. The operator then removes the cut-off casting inserts from the heater, places and locks them in the die and starts the casting machine on its next cycle while he reloads the heater. With this setup, the machine and a single operator can produce about 100 gates of castings per cycle, one right hand and one left hand frame.

To date, several dies for casting different window frame components have been altered to fuse-cast special parts and the savings over making completely new dies for these parts have been large. Products thus made are equal to the standard parts in all respects and perform the same function, though used on special bodies.

Although fuse-casting is a new process and is now employed only for special parts, it is believed that it can be used to great advantage by other die casters in the future. There are innumerable cases where castings are needed that are near duplicates of standard castings, yet the cost of complete new dies is prohibitive due to the comparatively small quantity of parts required. By using the fuse-casting technique in altered dies, these parts could be produced efficiently at a minimum cost.

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Magnesium as a Wear Resistant Metal

by E. L. SCHAPER,
Dow Chemical Co.

Magnesium sand elevator buckets lasted longer while weighing less than the malleable iron buckets they replaced.

Under certain operating conditions some magnesium alloys are successful in wear applications such as bearings, shafts and gears. Coatings of various kinds also improve their abrasion resistance.

● MAGNESIUM IS NOT generally looked upon as a wear resistant material. However, there are many cases where its other properties and economics would make magnesium an attractive choice of material if its wear resistance were adequate. In recent years, methods of improving wear characteristics of magnesium alloys have been developed and are now being improved. This article summarizes these advances and the present status of magnesium as a wear resistant material.

The Metal and Its Alloys

To date, few laboratory tests have been carried out on the wear resistance properties of the common commercial magnesium alloys; therefore, definite conclusions can not be made. The few comparative figures available indicate that although both increased alloy content and heat treating and aging do raise the hardness of the material, they increase the wear resistance only slightly.

In regard to methods of fabrication, the difference between cast and wrought magnesium does not seem to be significant, though users of die cast magnesium parts have many times claimed that a wear resistant skin effect has been noticed. This could be the result of a quickly chilled fine grained surface layer.

Special Alloys for Bearings—Experience has shown that under some operating conditions, certain magnesium alloys can be used directly as the bearing material, eliminating the need for bushings or inserted bearings. Several years ago considerable work was done along this line by one of the leading bearing manufacturers in cooperation with the Dow Chemical Co. The results of this work showed that some alloys such as magnesium + 6% tin, magnesium + lead, and magnesium +

20% cadmium + 10% lead had better bearing properties than the common commercial magnesium alloys. These findings were corroborated by other tests carried out in Germany which showed similar cadmium-lead alloys to have slightly superior bearing properties. The German investigations also make repeated mention of the non-seizing characteristic of magnesium bearings.

Although experimentation and some service experiences in using magnesium directly as the bearing metal have been successful under higher loads and more severe conditions, the usual recommendations are as follows:

1. Bearing loads should not exceed 2,000 psi.
2. Speeds should not exceed 1,000 ft per min.
3. Operating temperatures should not exceed approximately 230 F.
4. The steel shaft should be hardened or case hardened to at least 350 Brinell and preferably to a higher hardness such as 600 Brinell. The shaft should be polished and ground.
5. Ample lubrication should be provided.

In addition to these recommendations the freedom from abrasive grit or dirt, either metallic or nonmetallic, is desirable for magnesium alloys as well as any other bearing metal. Sharp edges or burrs, of course, should be avoided on the part which contacts the magnesium surface since the metal has excellent machining characteristics.

Automotive Industry—The German automotive industry in particular has experienced marked success in applying magnesium as a self-bearing material in cam shaft bearings, pushrod bearings and oil pumps. Reports indicate that all of the high production cars in Germany during the period before World War II used magnesium oil pumps, of which approximately 95% employed the cast magnesium housing directly as the bearing material for the shaft. The economic advantage gained through the ability of magnesium to be accurately die cast was the deciding factor in this case. This high casting accuracy plus the fact that the shaft hole could be cored so that only a one cut machining operation was required, resulted in an appreciable saving over the cast iron pumps. In this oil pump application, occasional excessive wear was experienced from the gear rubbing against the cover or body of the pump; however, this was eliminated by removing the sharp corners on the gear teeth which were actually machining the magnesium of the pump body or cover.

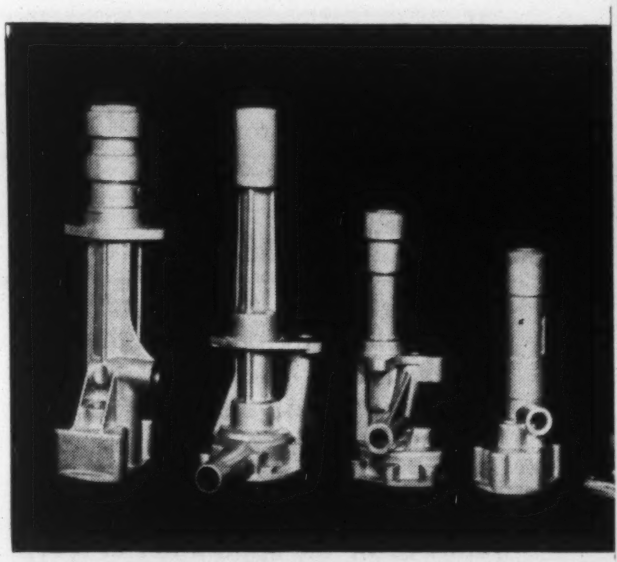
In this country also, several automotive companies have found success in laboratory tests on magnesium oil pumps where the magnesium housing serves directly as the bearing material for the shafts. At least one of these companies has carried the testing of these pumps to road test cars, most of which have accumulated over 40,000 miles to date, one over 87,000 miles, and periodic examination shows the magnesium to be performing well.

Other Applications—The unpredictable success of magnesium in so many applications involving wear almost dictates that the material be given a trial when there are other advantages to be gained from its use. For instance, the resistance of magnesium to sand abrasion is typified by the core boxes, flasks, pattern plates, bottom boards and sand elevator buckets used in foundries. In at least one case, a large manufacturer reported that magnesium core boxes used for blown cores showed wear resistance equivalent to that of aluminum, steel or brass and had the additional advantage of light weight. In the case of the endless belt sand elevator buckets the wear resistance of magnesium was found to be equivalent and in most cases far better than that of the malleable iron it replaced.

One manufacturer has been making extensive tests for over three years on magnesium housings and parts for the under side of automobiles. The tests have purposely included road conditions which could cause stone abrasion on the castings. Conclusions to date are that the magnesium shows no greater wear than other materials and that no shielding precautions are necessary. Magnesium has also been used successfully for grain scoops in the handling and unloading of grain from freight cars, and in baker peels used for removing pans of bread from bakers' ovens.

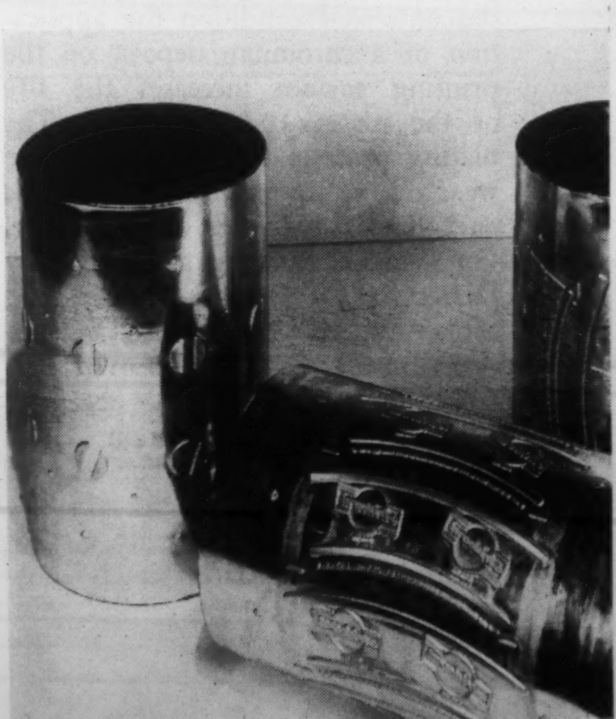
In the lawnmower industry magnesium is finding use for such parts as gears and pawls. After extensive wear tests on gear teeth, a manufacturer concluded that magnesium could satisfactorily replace a cast iron gear and wheel if an aluminum alloy pinion rather than one of cast iron or magnesium were used. At the same time tests were conducted on the impact abrasion resistance during the engagement of a pawl against the inside of the pinion. In this test the magnesium pinion was shown to be the best, the aluminum second, and the cast iron poorest of the three materials tested. Still another lawnmower manufacturer has used over one million die cast magnesium gears with complete success.

It goes without saying that many conditions of wear or abrasion are so severe that magnesium, as such, can not meet the requirements. When magnesium is used under such conditions, the parts must be protected by inserted sleeves, liners, plates, or bushings fabricated of a material with greater wear resistance properites. Since various methods of



Magnesium alloy serves as the bearing metal for the steel shaft in these die cast magnesium oil pumps for German cars and trucks.

Chromium deposits on these magnesium printing plates increased their printing life ten to twenty-fold.



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Abrasion resistance of magnesium core boxes for sand foundries has proved to be at least comparable to other metals used.

alloying or heat treating the metal do not greatly affect the wear resistance of magnesium, further improvements of this property are usually achieved by surface coating.

Coating the Metal

Plating—From the wear resistance standpoint and from the technological standpoint, one of the most significant recent developments in magnesium finishing has been the electroplating process. It consists essentially of a zinc immersion coating followed by the application of a copper flash and electroplating in standard plating baths. The resultant coating of copper, nickel and chromium provides wear characteristics similar to that of any other plated metal.

An example of this application can be found in the printing field. While magnesium printing plates possess outstanding printing life in the untreated condition the application of a chromium deposit on the printing surface increases the life of the plates 10 to 20-fold. The plating protects the metal from the wear due to the pigments in the ink and the clay coatings on the paper. For instance, previous plates used by Dixie Cup Co. for printing cups and containers, were copper-faced electrotypes from which 750,000 to 1,500,000 impressions could be obtained. With the long runs common in this industry, this often meant use of three to ten sets of electrotypes. By using magnesium plates with a chromium plated surface, it is now common to obtain 15,000,000 to 20,000,000 printed impressions from a single plate.

It should be pointed out that plating will not always hold up under highly concentrated or brinelling types of loads. Under such conditions the hardness of the base metal also becomes a determining factor in the load carrying ability of the surface coating.

Anodic Coatings—Several anodic finishes for magnesium are now available, but they are quite new and future testing of both present coatings and those under development will show their true value in wear and abrasion resistance. Though the optimum in anodizing magnesium has not as yet been developed, coatings such as the Dow No. 12, No. 14 and No. 17, have been in limited use.

Chemical treatment No. 12, or caustic anodize, is an anodic treatment employing an alkaline bath in which either direct or alternating low voltage current produces the coating. To date, its principal use has been in the textile field where its hardness and the fact that it does not "crock" or rub off onto the fabric make it preferable to paint coatings. Coatings of the No. 12 type are also in production use in the aircraft industry.

Chemical treatment No. 14, or a.c. anodic, is an electrolytic treatment in an alkaline bath with the use of high voltage alternating current. No. 14 is somewhat more abrasion resistant than No. 12 and in addition, has the ability to cover flow marks on die cast surfaces. Waxing of anodized parts is recommended to reduce smudging caused by handling.

Dow No. 17 Anodize is still under development; however it has been found to be more abrasion resistant than No. 12 or 14.

The anodic treatment known as the Simpson-Cutter Process, the Manodyze a.c. or d.c., or the CVAC No. 1 a.c. or d.c., has received considerable publicity, though no specific information on its wear resistance properties is available. Test results have indicated that coatings produced by this process provide good protection and paint base qualities.

A general comparison between some of the anodic treatments for magnesium is given in Tables 1, 2, and 3. These show results of tests made by an automotive manufacturer in an attempt to obtain the maximum wear resistant magnesium surface for a particular application. In conducting these tests, several specimens of magnesium, protected by various types of anodic coatings were used. Table 1 shows the result of a modified Taber abrasion test with a highly polished steel disk used in place of the usual calibrase wheel. In obtaining the results shown in Table 2, a cast iron wheel was used, and for Table 3 a non-various friction dynamometer was employed to compare the effectiveness of various lubricants.

Unfortunately, the tests were made with a specific application in mind, and, therefore, do not comprise a comprehensive evaluation of the anodic coating field. However, the results are interesting in that they give an idea of the variance between some of the anodic coatings available.

Another electrochemical coating for which excellent wear resistance is claimed is the HAE coating. In a recent article, H. A. Evangelides, developer of the process, stated that the process produces a refractory coating possessing excellent corrosion, heat and abrasion resistance, and is exceptionally hard. The Moh's scale hardness is estimated at between 7 and 9 which is hard enough to polish Rc 65 steel. To measure abrasion resistance, the HAE finish was tested on a Taber Abraser. Results of the test using Calibrase Wheels CS17 and a 1,000 g weight showed no breakdown of the coating after 8,000 cycles.

In both service experience and laboratory tests on the wear resistance of the various anodic coatings, Dow has found that applying an oil, grease, or wax usually prolongs the life of the coating. Further improvements have been obtained by impregnating the coatings with colloidal graphite. Corrosion by the graphite is eliminated by the anodic coating acting as an insulating separator on the magnesium surface.

Sprayed Metal Coatings—Various types of metal spray coatings have been applied to magnesium with claims of varying degrees of success. One of the latest is a combination chromium-tungsten spray which is reported to produce a hard, wear resistant surface.

Although the cost of metal spraying is usually greater than that of electroplating, when the shape of the part presents plating problems or when the coating must be restricted to certain areas, metal spraying eliminates the need for special anodes or stop-off lacquers. A good bond between the sprayed coating and the magnesium is a requisite for any sprayed metal coating.

Chemical Treatments — Chemical treatments, such as the chrome-pickle and dichromate are of the surface conversion type for pre-paint treatment and have little value in increasing wear resistance. Their primary value from the standpoint of wear resistance is in the way of providing increased adhesion for subsequent paint coatings.

This article was adapted from a paper presented at the SAE Annual Meeting, Jan. 1953.

Table 1—Modified Taber Test* on Coated Magnesium and Aluminum Die Castings

Material and Coating	No. Revs. to Wear Thru Coating
Magnesium Dow 7 (Dichromate)	800
Magnesium Dow 9 (Galvanic Anodize)	1,000
Magnesium Dow 12 (Caustic Anodize)	3,000
Magnesium Manodized, A. C. Current	2,600
Magnesium Manodized, D. C. Current	3,500
Experimental Magnesium Anodize	22,000**
Aluminum Anodize (Sulfuric Acid, Heavy Coating)	22,000**
Aluminum Anodize (Chromic Acid)	2,000
Aluminum Anodize (Sulfuric Acid, Light Coating	3,000

* *Highly polished 1020 steel disk used in place of usual calibrase wheel. Test run with both surfaces dry. 72 R.P.M.*

** *Removed, no significant wear.*

Table 2—Abrasion Test of Coated Magnesium and Aluminum Against Rotating Cast Iron

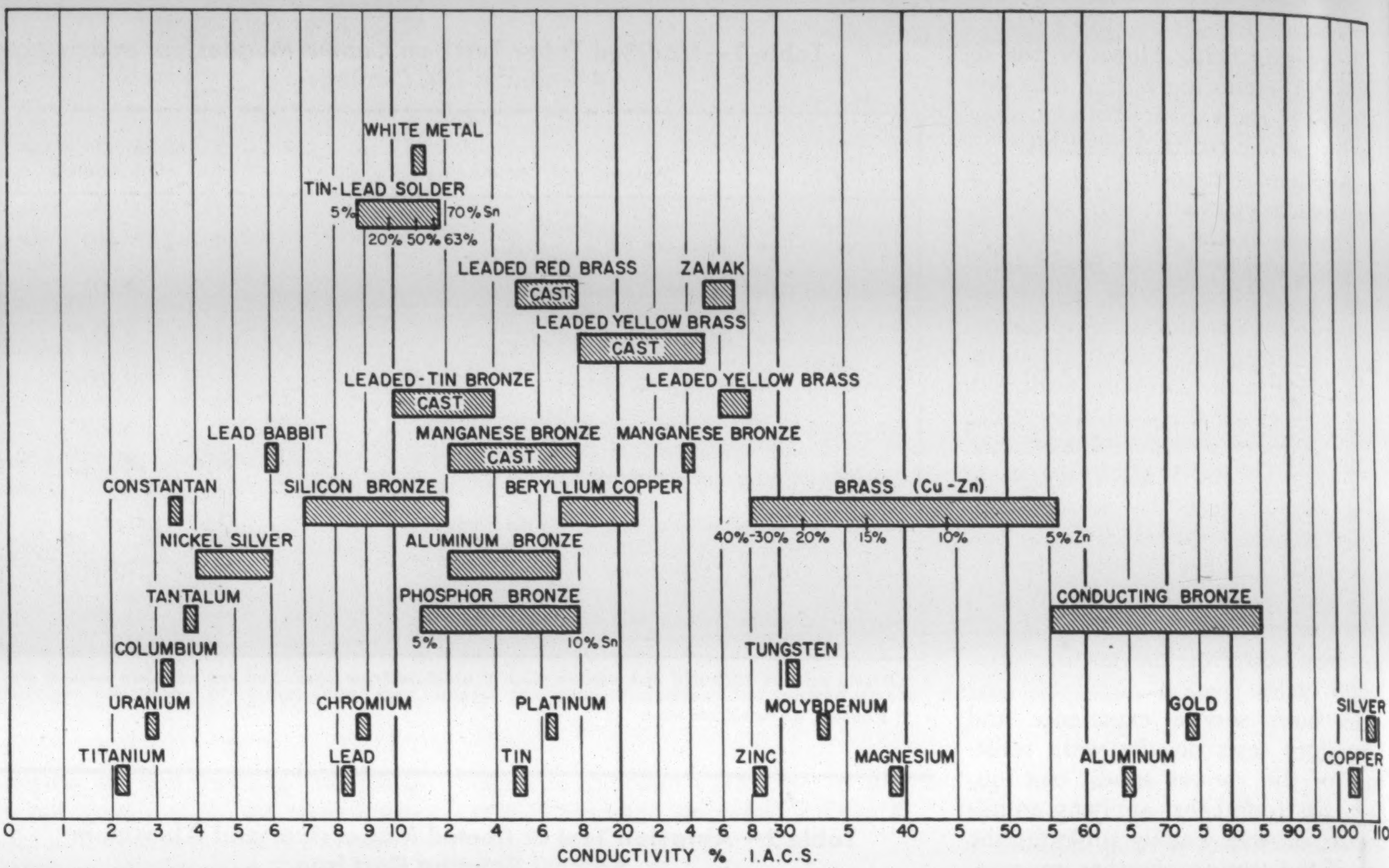
Material and Coating	% Casting Worn*	Average Frictional Force at 200 psi load
Magnesium Dow #12 Anodize	80	21.8
Magnesium Manodized A. C. Current	75	22.8
Magnesium Manodized D. C. Current	45	23.7
Experimental Anodized Magnesium	3	23
Anodized Aluminum (Sulfuric Acid-heavy coating)	5	19.5

* *Same number of revolutions for each specimen.*
All specimens lubricated with 10 W oil.

Table 3—Comparison of Effect of Various Lubricants on Anodized Magnesium and Aluminum Coatings

Material and Lubricant	Coefficient of Friction (Kinetic)
Magnesium R Alloy (Without lubricant)	0.16
Magnesium Dow #12—10 W Oil Lubricant	0.12
Magnesium Experimental Anodized—Without Lubricant	0.17
Magnesium Experimental Anodized—Graphite + 10 W Oil Lubricant	0.12
Magnesium Experimental Anodized—10 W Oil Lubricant	0.16
Magnesium Experimental Anodized—Waxed	0.10
Aluminum Die Cast 380 Alloy—10 W Oil Lubricant	0.14
Aluminum Anodized (Sulfuric Acid, Heavy Coating) 10 W Oil Lubricant	0.19

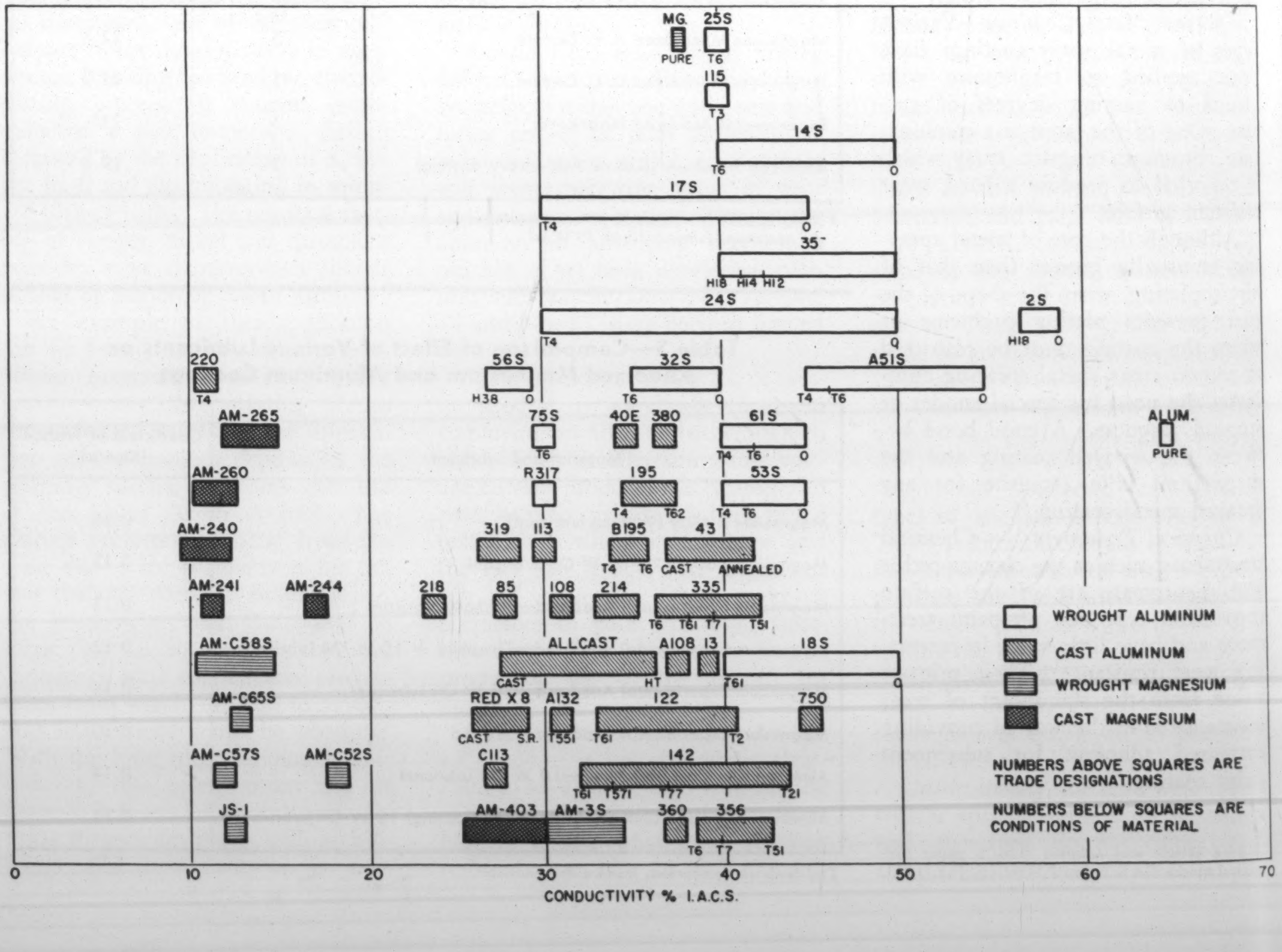
Test made on non-various friction dynamometer.



Electrical conductivity of various metals and alloys.

Conductivity—

Electrical conductivity of aluminum and magnesium alloys.



A new, practical instrument developed in Germany, directly measures electrical conductivity of materials . . . Can be used for sorting nonferrous metals and alloys, identifying unknown metals, evaluating hardness and checking heat treating results.

Measuring conductivity of a nonferrous alloy to insure proper quality before cutting and processing.

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Now a Useful Nondestructive Testing Tool

by HENRY N. STAATS, Magnaflux Corp.

● CONDUCTIVITY IS A well known physical property which has been applied to various tasks, but its value in nondestructive testing has never been fully appreciated because of the lack of conveniently rapid instrumentation, applicable to unsectioned parts of industrial shapes. Now, however, an electronic conductivity meter, which quickly measures conductivity directly has been made available in this country.

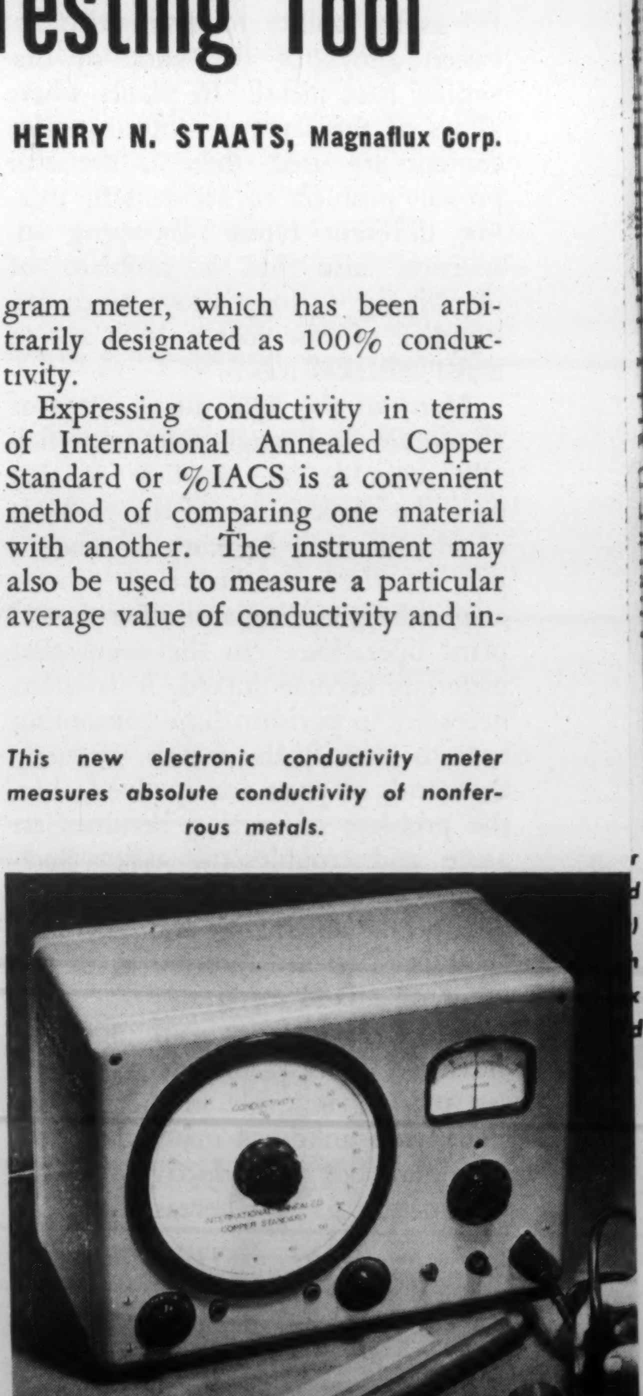
Developed in Germany, where it is known by the trade name Sigmatest, this instrument is based on the theory of inducing high frequency eddy current in materials and detecting the effect of this current upon the measuring coil or probe itself. In this country, the instrument is now available under the designation Magnatest conductivity meter.

Specifically, this instrument measures absolute conductivity of nonferrous conducting materials directly by means of a convenient, hand held probe. The unit is easily calibrated with known conductivity specimens supplied with the instrument. Temperature of the material to be tested has little or no effect if the calibration samples are allowed to stabilize to the temperature of the test samples. The presence of moderate amounts of oxides, scale. paint, surface roughness, or dirt has little or no effect on the 2% full scale accuracy of the instrument. A reasonably flat area of one-half inch diameter is required for readings and it is not necessary to make electrical contact with the test piece.

The instrument is so constructed that it may be used to measure absolute conductivity directly in per cent of International Annealed Copper Standard. Standard conductivity has been defined by the International Electro-technical Commission in terms of the amount of resistance to be found in a specified grade of high purity copper when measured at 20 C. (68F). This resistance amounts to approximately 0.15 ohms per gram meter, which has been arbitrarily designated as 100% conductivity.

Expressing conductivity in terms of International Annealed Copper Standard or %IACS is a convenient method of comparing one material with another. The instrument may also be used to measure a particular average value of conductivity and in-

This new electronic conductivity meter measures absolute conductivity of nonferrous metals.



dicate deviations from this average in plus or minus calibrated readings on a separate indicating meter.

This practical instrument thus enables the engineer to make use of conductivity as a nondestructive test and his job is made even easier because of the availability of great quantities of data in standard references.

Sorting Metals and Alloys

Most non-ferrous pure metals can be readily distinguished from one another by their conductivities. For example, pure lead has a conductivity of 8 to 9%. Gold ranges from 72 to 77%. Tungsten is found in the range from 31 to 32%. Silver will be found at approximately 102% IACS. An accompanying chart illustrates some of the conductivities of pure metals and a few of the more common alloys. The relatively narrow ranges of conductivities of the pure metals make it comparatively easy to sort one from the other. The obvious application here would be for the sorting of scrap materials.

The ability to distinguish between pure metals is not nearly as useful as the ability to distinguish between alloys of the same or dissimilar base metal. In plants where alloys of the same or differing alloy content are used, there is the ever present problem of accidentally mixing different types. Incoming inspection also has a problem of identifying various alloys since the supplier of raw materials is apt to make mistakes too.

Many of the light metal alloys of aluminum and magnesium superficially resemble one another so that once the stock is mixed the problem of identification becomes as much a part of the manufacturing process as grinding, cutting and other typical plant operations. In the event that materials become mixed, it is often necessary to perform time consuming tests to identify the metals. If many thousands of parts are involved, then the problem of sorting becomes an acute and troublesome task. Such tests as hardness, spark identification, density measurement, and chemical analysis often are resorted to in the event of mixed materials.

Since conductivity can now be measured quickly and decisively, it can play a vital role in the task of identifying unknown materials. Pure aluminum has a conductivity of approximately 65% whereas a typical high strength alloy has a conductivity of about 50%. Permanent mold casting alloys A-214 has a conductivity of 33% and commonly is used in the manufacture of cooking utensils. Aluminum alloy 220 frequently is used for aircraft fittings where good machineability and resistance to corrosion is desired. This material has a conductivity of approximately 21%

From the foregoing it would appear that measurement and interpretation of conductivities is a simple operation. The measurement itself is quite simple, however the interpretation is sometimes more complex than these simple figures would seem to relate. Many of the values of conductivity listed in the references indicate variations in value due to the fact that metals can exist in more than one state or condition. For an example: certain types of copper chromium alloys have a conductivity ranging from 30 to 35% IACS when measured in the wrought and quenched states. The same alloy, after precipitation hardening may have conductivities ranging from 80 to 90%.

Almost all alloys have ranges of conductivities and frequently there is an overlapping of values. The accompanying chart shows a few of the light metals and their conductivity values. This overlapping illustrated cannot be avoided since it is the nature of the material which governs the conductivity. The measuring instrument itself should not be blamed for the sins of the metals and their alloys. Despite occasional overlapping, conductivity is still a useful adjunct to the other tests commonly used in the identification and sorting of mixed metals and alloys.

The segregation of cooking equipment aluminum alloys from aluminum extrusion stock used in aircraft work is no problem to the manufacturer of airframes since it is unlikely that both alloys will be on the premises. However, the sorting of identical alloys which may be at various physical states is of consequence.

Evaluating Physical Properties

The fact that many physical properties of light metal alloys are related to conductivity expands the usefulness of this simple nondestructive test. The conductivity of aged aluminum alloys is definitely associated with hardness. During the last war in Germany, extensive use was made of the relationship between hardness and conductivity, particularly in the aircraft industry. This relationship proved to be exceptionally useful and time saving for checking pressed parts made of aluminum-copper-magnesium alloys. Here, two calibration samples of known hardness were used to determine the range of tolerance. It also was noted that conductivity parallels hardness for aluminum-magnesium-zinc alloys when the materials were quenched at different temperatures. Under some conditions, conductivity appeared to be a better indicator of the desired technical properties than Brinnell hardness.

Incomplete quenching of light metal alloys often results in the development of soft zones. Occasionally this same type of flaw occurs at the end of extruded sections. If a rapid probe scanning of the surface is made to determine the variation in conductivity, the softer zones may be readily detected and steps taken to correct the process. It is obvious that it is easier to scan a complex shape with a probe than to measure hardness by conventional methods.

Another important use to which conductivity can be put is the control of certain physical qualities while the metal is still in the crucible. People who melt copper may rapidly check conductivity of a small cooled sample and relate it to the phosphorus content. If the melt is insufficiently oxidized the batch can be adjusted and a small sample taken periodically until a permissible conductivity reading is taken. This same general technique may be used in casting of alloys of high copper content, particularly the conducting tin and lead bronzes. The determination of purity of aluminum can be carried out in a similar manner.

In summary, it is evident that conductivity is a useful nondestructive testing property which until comparatively recently has not been extensively used. This physical property was discovered many years ago and used to a limited degree. Until the development of a practical test instrument such as described here, the advantages of the measurement of conductivity could not be realized. The use of this interesting and valuable physical property can now be achieved and is restricted only by certain inherent limitations and the ingenuity of the user.

PICTURE CREDITS: Ampco Metal, Inc. Data for conductivity charts taken from "Metals Handbook".

New Elastomer-Impregnated Leather

• *Gives complete porosity control in sealing applications.*

by **ALFRED S. BERENS, Chief Chemist, Chicago Rawhide Manufacturing Co.**

• DESPITE THE WIDE acceptance of elastomers in shaft seals, packings and similar types of protective devices, there remain many applications in the automotive, hydraulic, and pneumatic fields where leather is the most desirable material. The reason is that leather permits lubrication through the sealing member, which is not possible with homogeneous materials. However, the problem in leather seals has been control of porosity. But now performance test results on a new elastomer impregnated leather, called Conpor, indicate porosity control has been accomplished in leather sealing members.

Basically, the new material consists of high-quality leathers usually chrome retan) impregnated with Thiokol liquid polymers, which when cured have no true melting point, but which will eventually soften at temperatures in excess of 300 F. The impregnated leather remains flexible at temperatures as low as —70 F. Once the leather is treated, the impregnations are so insoluble in oils and organic solvents that they cannot be removed for examination. However, when prepared as a pure casting (without leather) only about 1% of the impregnant is soluble when extracted with solvents such as gasoline, petroleum ether, hexane, or mineral spirits, while about 6% is dissolved by extraction from a cast sheet by chloroform, benzene, or carbon tetrachloride.

There is practically no change in the volume of Conpor upon oil immersion. After 72-hr tests in SAE 20 crankcase oil at 250 F, swelling was recorded at about 1%. Hypoid lubricants at the same temperature showed about 1% shrinkage.

The potential range of porosity among the series of these impregnated leathers is from zero to 100% (based on the original leather porosity). Broadly, they are divided into two categories—full thickness and limited depth impregnations. The choice is, of course, determined by the requirements of the application, but within each of these two general categories, there is a variety of formulas which also govern the porosity in accordance with the liquids to be sealed.

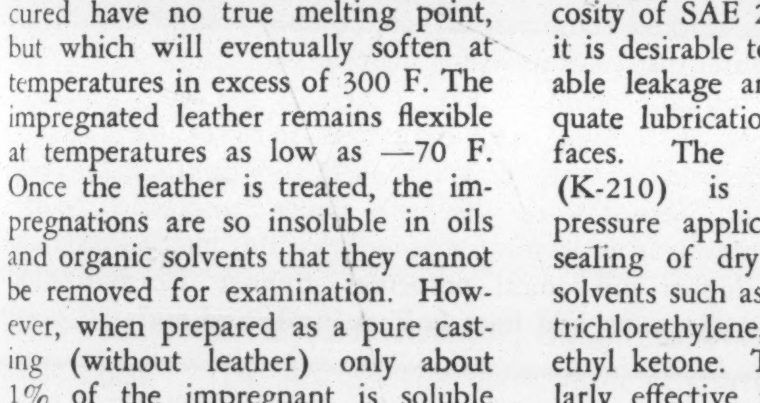
The full-thickness modifications come under three broad series. The most porous (K-220) is recommended for standard shaft-type oil seal applications for oils of the viscosity of SAE 20 and higher, where it is desirable to eliminate objectionable leakage and still provide adequate lubrication at the contact surfaces. The second modification (K-210) is suggested for low pressure applications involving the sealing of dry cleaning and other solvents such as carbon tetrachloride, trichlorethylene, benzene, or methyl ethyl ketone. This series is particularly effective in many applications which could not be satisfactorily handled with synthetic rubber, and where the porosity of leather had previously been objectionable. The third modification (K-220) is intended chiefly for hydraulic and pneumatic packings operating at pressures up to at least 2000 psi.

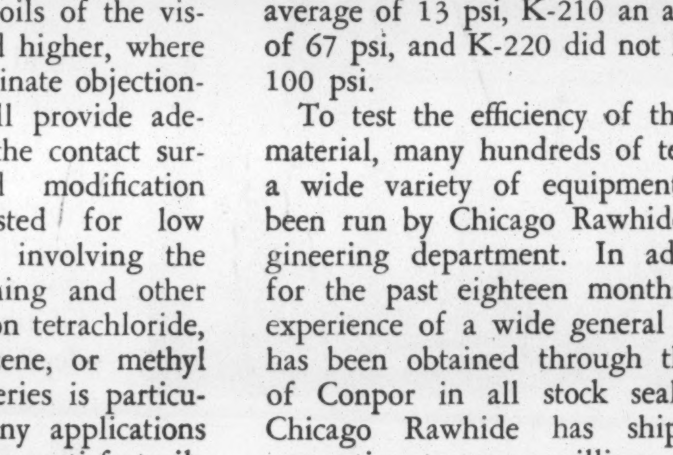
The accompanying chart indicates the degree of superiority of elastomer impregnated leather over the traditional type of wax impregnated leather, not only for reducing the leakage at normal room temperature but, particularly, for drastically improving performance at elevated operating temperatures. Another chart shows the long life with low leakage that can be expected with these leathers. The differences among the three series is evident by comparing the results of static permeability tests run on disks using an SAE 10 oil at 4 psi: an untreated leather leaked 179 gm of oil, while a K-200 Conpor leather leaked only 3.2 gm in the same length of time. In other static tests, using flange packings for sealing air pressure, untreated leathers were able to seal only 3 oz per sq in. while K-200 sealed an average of 13 psi, K-210 an average of 67 psi, and K-220 did not leak at 100 psi.

To test the efficiency of the new material, many hundreds of tests on a wide variety of equipment have been run by Chicago Rawhide's engineering department. In addition, for the past eighteen months field experience of a wide general nature has been obtained through the use of Conpor in all stock seals that Chicago Rawhide has shipped—amounting to many millions.

Cost experience on elastomer impregnated leather has, to this point, been favorable. A constant controlling factor is, of course, the market on hides. Beyond that cost, savings are substantial where limited depth impregnations can be used and in all cases, the new treatment compares favorably in cost with other forms of fillers.

Long life with low leakage can be expected with these leathers.





How elastomer impregnated leather (Conpor) compares with traditional wax impregnated leather.

Materials at Work

Here is materials engineering in action . . .

New materials in their intended uses . . .

Older, basic materials in new applications . . .

Metal Tubes Formed by Cold Sizing

Precision hot forming provides an assortment of shapes and forms for tubes which have been cold sized by the compression forming method developed by Tube Reducing Corp. Compression sizing, one of the newer methods of cold forming tubing, can be used with carbon and alloy steels, stainless steels, copper and brasses, titanium and many other of the less common steels which are becoming increasingly important today.

In compression sizing the tube is held stationary between a pair of special dies that rock back and forth over its longitudinal axis, compressing the wall of the tubing against a mandrel. The tubing metal is thus worked compressively and evenly around the highly polished mandrel that controls inside diameters.

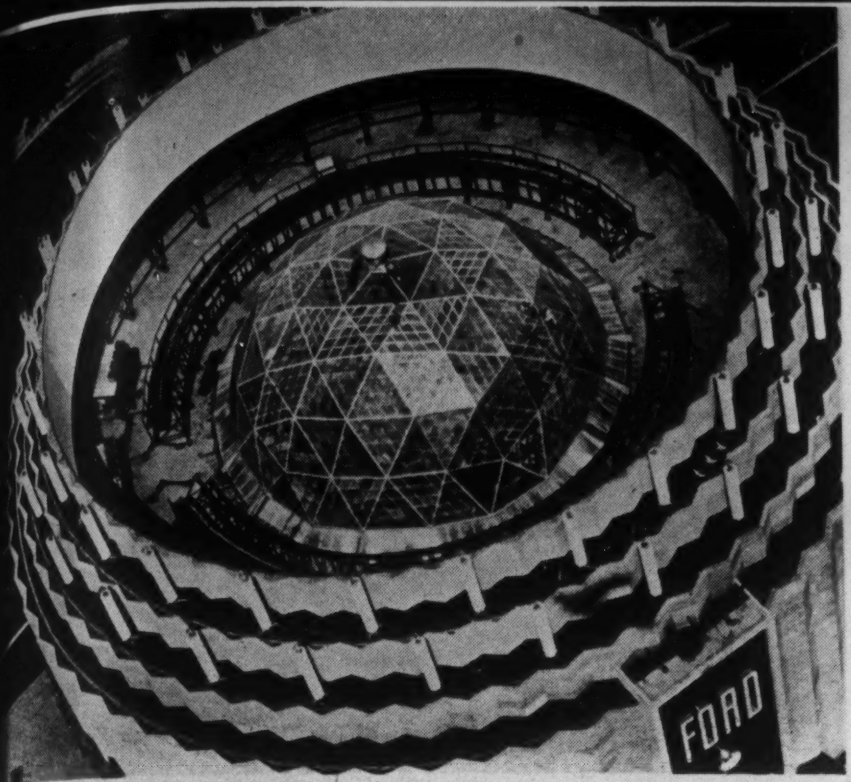
This cold forming method reduces materially the scrap generated by other types of forming, and minimizes some of the common troubles encountered in cold drawing, such as wrinkling, buckling and fracturing. Since it works the metal under compression, rather than under tension, as in drawing, it is said that this method produces tubing with higher mechanical properties, thinner decarburization depths, closer tolerances, and finer finishes inside and out.

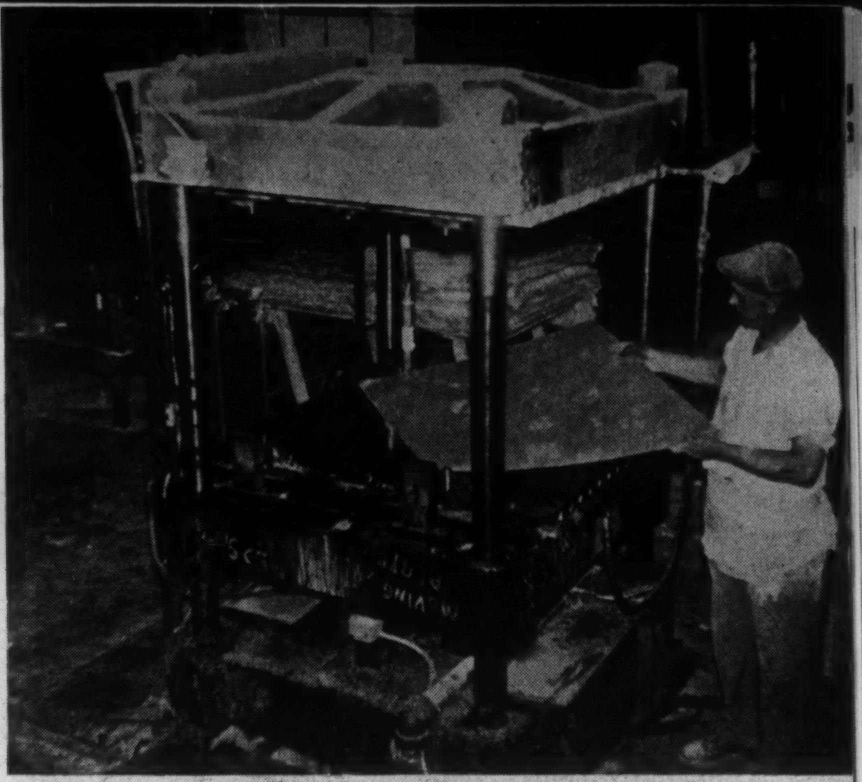
Tiny Steel Precision Bearings

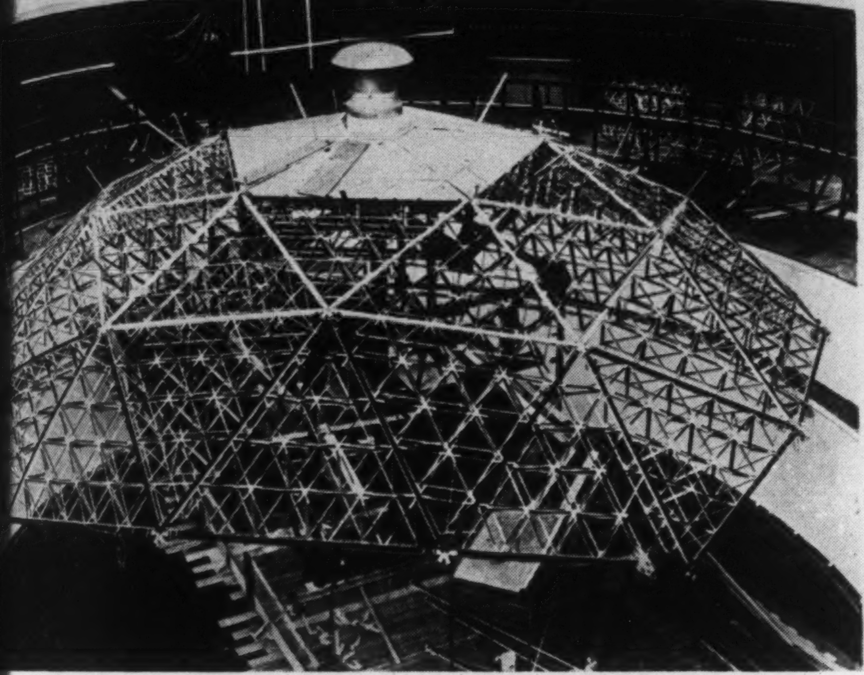
In line with the present-day emphasis on miniaturization of assemblies, Miniature Precision Bearings, Inc. is producing ball bearings ranging from 5/16-down to 1/10-in. o.d. The bearings are made of high carbon chromium bearing steel (SAE 52100), and most of them are available in 440 stainless. A number of bearings are available in beryllium-copper for nonmagnetic installations.

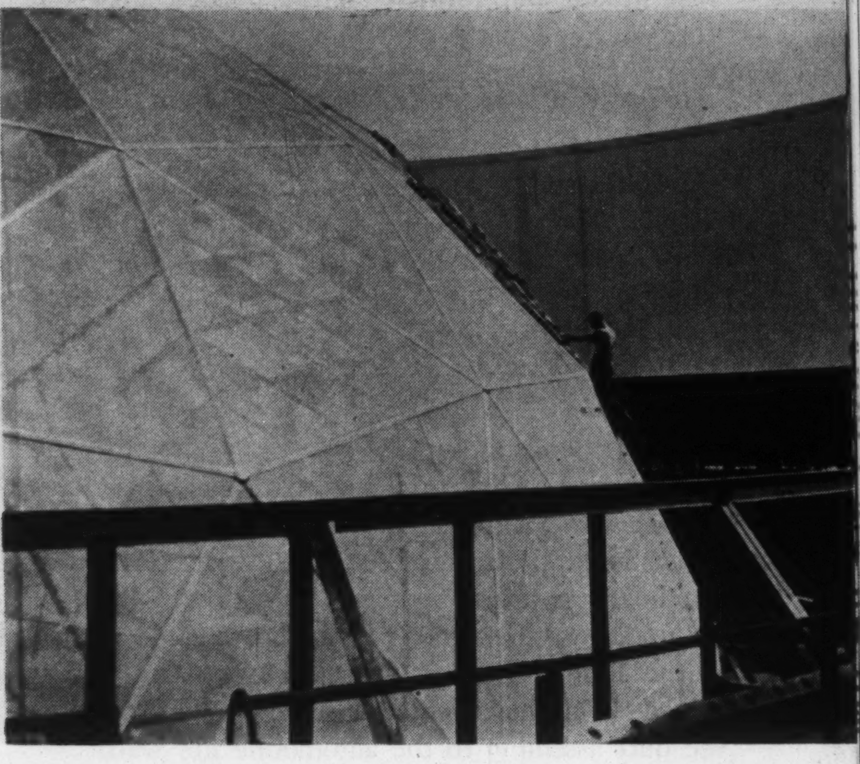
Various types of bearings are manufactured, such as radial, pivot, angular contact, flanged and thrust, while others are fabricated specially to meet a particular need, such as a magneto type bearing with threaded o.d., grooved radial bearing, flanged pivot bearing, etc.

The size and accuracy of these bearings make them applicable for use in drive movements of recorders, time clocks, barometers, valves, metering devices, and for instruments of delicate responsiveness such as electrocardiographs, inclinometers, and many types of electronic equipment.









Glass-Reinforced Polyester Reduces Weight of Geodesic Dome The first geodesic dome, made of sheets of glass-reinforced Bakelite polyester resins, was erected when the Ford Rotunda was remodeled for the observance of that company's 50th anniversary.

The dome rests on the wall of the inner court, 60 ft above the floor, and rises to a height of 106 ft at the apex. It is 93 ft in dia and weighs 8½ tons, as compared to 160 tons for a steel dome of the same size. Produced by Molded Fiberglass Sheet Co., the sheets, impregnated with Bakelite polyester resins, have high mechanical strength. Designed to support a snow load of at least 30 lb per sq ft, the dome owes its strength to the structure of both the aluminum framework and the translucent skin. The triangular skin sheets, about 1/25 in. thick, 15 ft on a side and weighing about 30 lb, were assembled from smaller, diamond-shaped sheets of the plastic.

Lightness of materials, method of assembling the aluminum trusses and a unique construction process that resembled the raising of an umbrella aided the completion of the dome in 30 working days.

Titanium Alloy Castings Titanium alloy castings of complex shape weighing up to several pounds are now being produced in pilot quantities by the National Research Corp. The castings are produced in a vacuum arc furnace using special molding material which has been developed to withstand attack by molten titanium.

Carbon, oxygen and nitrogen content are reasonably comparable to commercial wrought titanium, and the surface is equal to that of good sandcast metals.

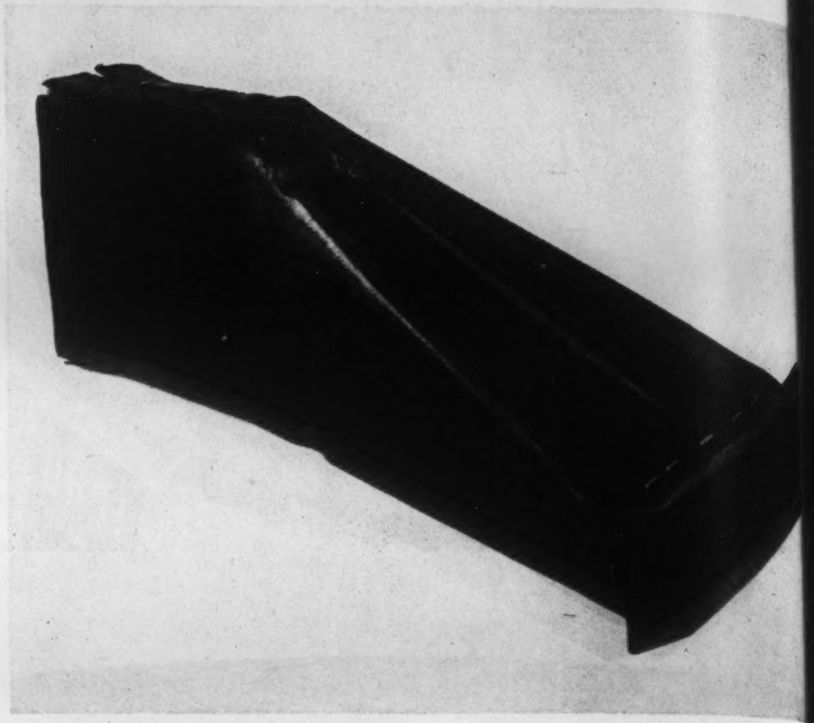
Materials at Work

Wire Stitching Speeds Auto-Part Production

Woodall Industries, Inc.—suppliers for automotive manufacturers—operate 44 stitching machines to speed the assembly of certain automobile components fabricated from flexible, heavy duty fiberboard and metal. Engineers of Acme Steel Co. and Woodall cooperated in planning the most economic use of the stitching machines, which include both carton-type and metal-stitching units. Matching the type machine to a specific job is dependent upon material hardness and thickness as well as resistance to penetration. Where stitching to metal is not required, standard carton-type Silverstitchers are used. A "sealing" stitch can be rapidly applied around the outer edges where two layers of fiberboard must be joined together. The fiberboard is first heated and formed on die presses, then the preformed basic parts are transferred to assembly lines where the required metal parts are stitched in place.

One of the assemblies presently in production is the heater distribution duct which requires three separate metal-stitching machine operations followed by the "sealing" stitch performed by carton-type stitching machines. These operations include a felt-to-metal stitch, a metal-to-metal stitch and a metal-to-fiberboard stitch, followed by the fiberboard-to-fiberboard stitch. Stitches are also used to secure the spacers providing the necessary gap to permit air to flow into the passenger compartment of a car.

Pre-formed fiberboard halves of the heat exchanger-to-dash duct are joined with stitches of flat wire. Carton-type stitching machines secure the two 0.093-in. thick fiberboard sections together. Stitches of 18 gage wire are used to secure a 0.065-in. rubber-covered metal collar to the end of the duct after the two halves have been joined. This metal collar is used to permit bolting of the duct assembly to the automobile fire wall.



Porcelain Enamel and Cellular Glass Combined in Curtain Wall

A new curtain wall for construction use employs a combination of porcelain enamel as a face surface and cellular glass as the core insulating material. With the new construction, front and back skins of the wall panel completely cover the cellular glass and are held in position with insulating concrete. There are no voids permitting penetration of water or water vapor that could cause deterioration over a long period of years. The completed wall is approximately 2 in. thick and weighs 7 lb per sq ft.

Developed by Barrows Porcelain Enamel Co., it will be used for exterior walls in a school now being built in Kansas City.

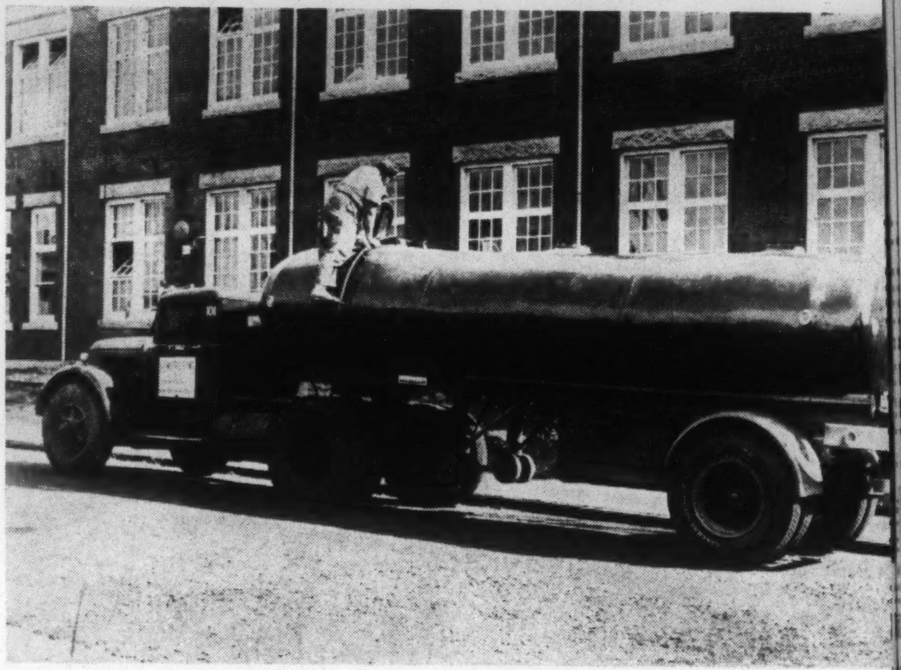
The new type construction represents a compromise in securing a non-load bearing wall that is weatherproof, light in weight, has good insulating qualities, will not deteriorate nor form moisture traps or act as a hygroscopic agent. Other features of the new wall are its low maintenance cost, proof against vermin, long life based on porcelain enamel, incombustibility, and dimensional stability.

Materials Selection Aids Truckers in Increasing Pay Load

New uses of light weight materials are now aiding trucking companies in reducing the dead weight tonnage of their truck bodies and thereby increasing their pay load. Two recent developments, magnesium for dry goods hauling, and plastics for the transportation of fluids, are said to reduce operating and maintenance costs as well as increase the allowable cargo tonnage.

The 3400 gallon reinforced plastic transport tank (shown at bottom), the largest of its kind, has been fabricated by the Beetle Plastic Co., for the Mutrie Motor Transportation Co. The tank was manufactured over a wood mold. Laminac, a polyester resin developed by American Cyanamid Co., was sprayed on the mold, layers of glass mat were added and a specially catalyzed resin was spread over each layer. Due to the corrosion resistance of the plastic, no liner is needed for the tank and it is particularly adaptable for the hauling of chemicals and other corrosive liquids. When mounted on the trailer, the tank weighs 7025 lb as compared to the 10,625-lb weight of the steel tank it replaces. It is approximately 22 ft long, 6 ft wide and 4 ft high unmounted. The dent-resistant fenders and the hose and pump compartments are made of the same plastic-glass material as the tank.

Another development in the line of light weight truck bodies has been made by the White Metal Rolling and Stamping Corp., which is now producing truck bodies of their Whitelight magnesium. The 12-ft van type body (top), complete with roof and double back doors, has a capacity of 621 cu ft yet weighs only 850 lb. A steel body of the same cubic capacity would weigh about 2200 lb, and an aluminum body about 1300 lb. The frame of the truck is made of extruded magnesium structural sections, designed to incorporate durability with the light weight feature. The panels are of magnesium alloy sheet and the entire body assembled with 56-S aluminum alloy rivets.



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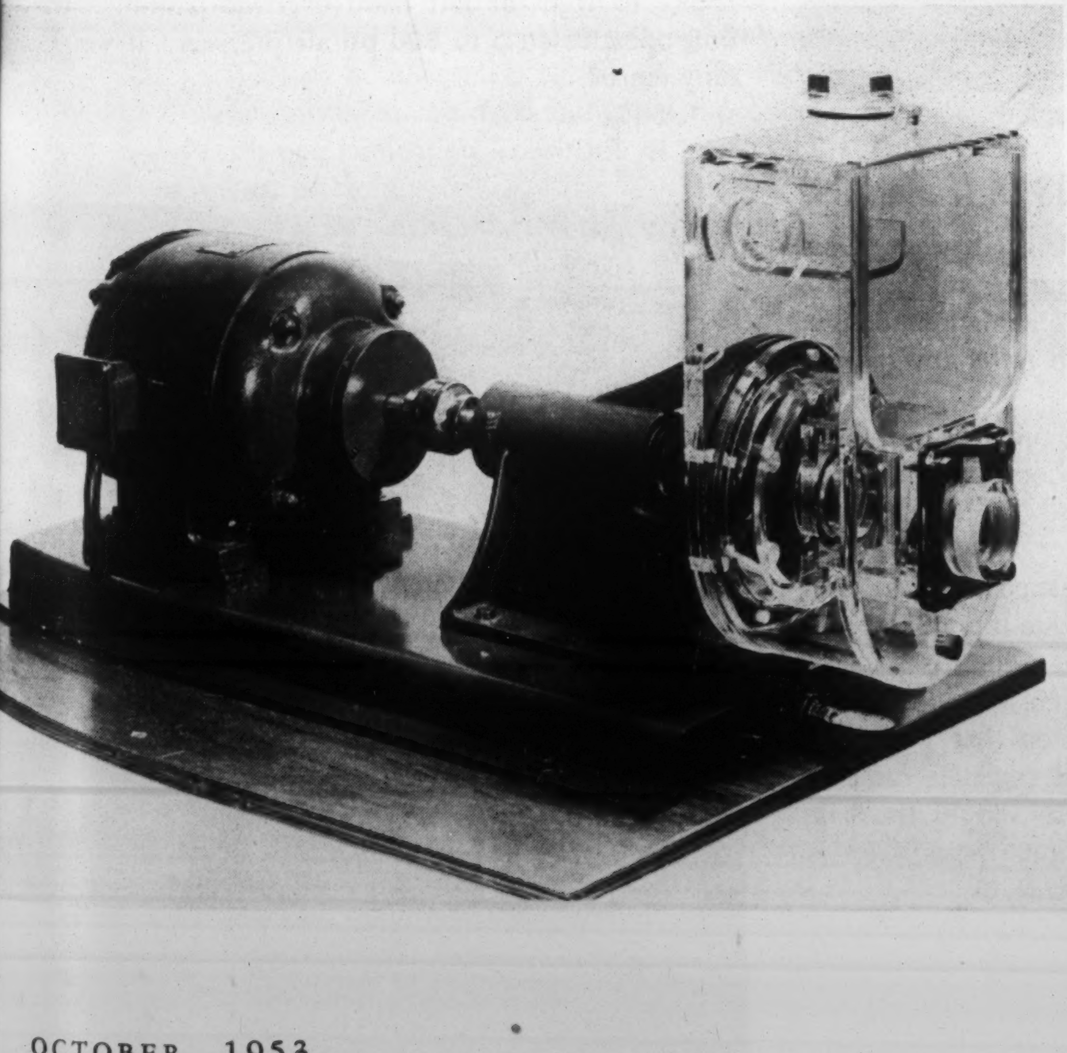
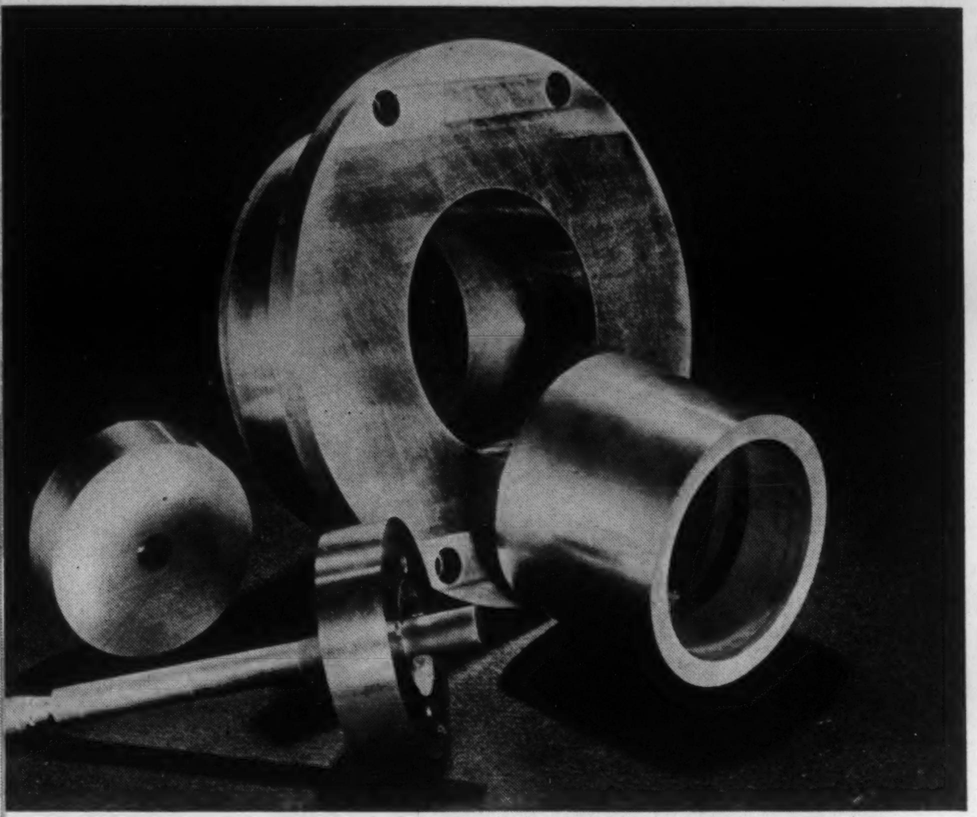


Plastic Model Aids Pump Development

Certain types of plastics, as well as being advantageous manufacturing materials, can also be used effectively in the research and development of products. The Marlow Pump Co. has found the transparent characteristics of Lucite of great help in their pump development. A transparent model was fabricated by the Marlow Co. to aid in the design development of their line of centrifugal steel pumps.

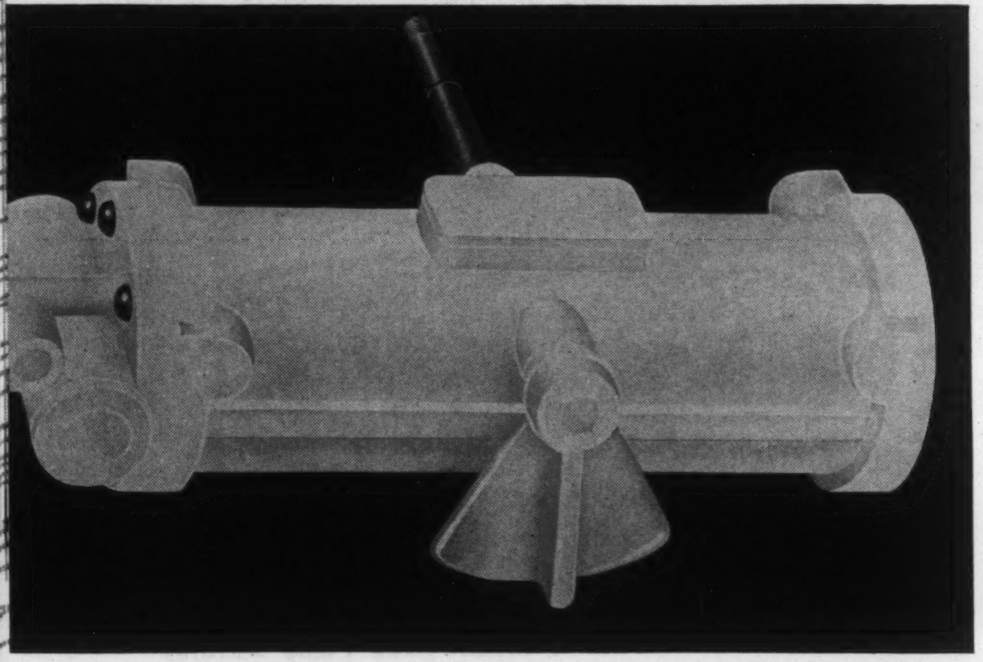
The model, machined from ½-in. Lucite and assembled and seamed by Kay Plex Co., handles a working pressure of 30 psi. It is 30 in. long, 20 in. high and 14 in. wide. The company says the use of this model resulted in the development of a more efficient design for an increased capacity.



TUNGSTEN CARBIDE MOLD LINERS

Carboloy tungsten carbide mold inserts used in producing silicon carbide and aluminum oxide grinding wheels 1/8 to 4½ in. in dia at the Carborundum Co. are providing an overall average working life about ten times that of other engineering materials. A 4-in. mold on an automatic press, for instance, produced as many as 86,000 pieces and was still in good condition. The mold employed previously lost its efficiency at the end of 2500 pieces.

Cost of the tungsten carbide molds, according to Carborundum, averages about three times that of steel but is more than offset by the wear-resistant qualities of the tungsten carbide.



NYLON WINDSHIELD WIPER MOTOR

Sprague Devices, Inc. is now manufacturing a new windshield wiper motor for heavy trucks, fabricated from DuPont Nylon. Because of the superior toughness and abrasion resistant properties of this synthetic plastic, the new Air-Push motor gives longer life with less maintenance.

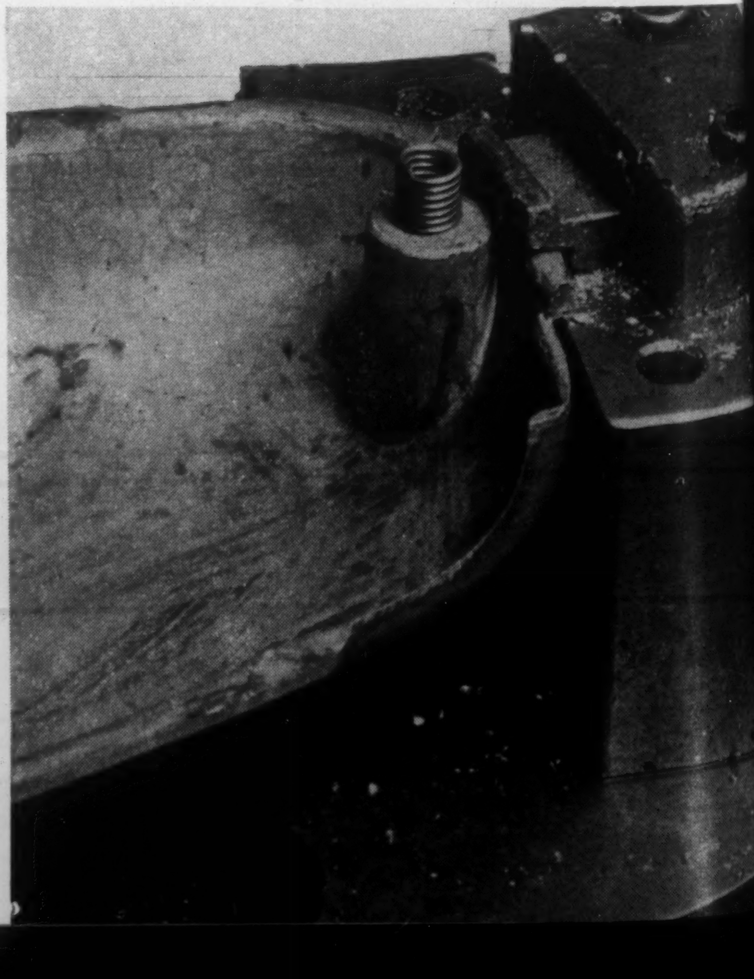
In the construction of this unit, no springs are used. The only steel parts are the screws and stainless steel shaft. There are only three moving parts. Other features of the motor include "O" ring construction in valve and piston, high torque output and choice of right or left hand override parking. The unit operates on 5 to 120 psi air pressure. It weighs only ten oz.

WIRE INSERTS FORM STRONG THREADS IN MAGNESIUM

In converting the side covers of their calculating machine from aluminum to magnesium castings, the engineers of Marchant Calculating Machine Co., reduced the weight of their design. But to accomplish this change they had to offset low tapped thread strength of magnesium.

Required strength in the metal was obtained by installing thread inserts produced by the Heli-Coil Corp., into the prepared thread bosses of the cast side covers. Three inserts are used in each cover.

The inserts, helical coils of diamond-shaped stainless steel wire, serve three purposes. First, they provide internal threads having a tensile strength up to 50% greater than is possible in the magnesium alone. Second, the tight-fitting stainless steel inserts prevent the electrolytic corrosion that would result in corrosion if standard steel threaded fasteners came in direct contact with the magnesium. Third, should the side plates ever need removal for servicing the inner parts, there is no risk of damage to the protected tapped threads.



GLASS FIBER LAMINATIONS IN CRUISER'S HULL

Large boats as well as small ones may be repaired and strengthened with glass fiber reinforced plastic. Catawba Marine Sales covered the hull of a 31-ft fishing cruiser with three laminations of fiber glass cloth and resin and also replaced the canvas on the deck and cabin top of a 32-ft cruiser with one lamination, consisting of one layer of cloth and three of resin.

The new covering on the bottom of the large fishing cruiser was installed primarily to give the boat added strength. It also has an extra advantage in that this covering will prevent the plywood bottom from absorbing water. It is estimated that a boat of that size with a plywood bottom ordinarily absorbs a half ton of water during a season. Without this 1000 lb of additional weight the cruiser should function more economically and travel as fast at the end of the summer as when it was placed in the water at the beginning.

The fishing cruiser, unlike small boats, could not be turned upside down while the work was in progress. Consequently the covering operations resembled somewhat the hanging of wallpaper on a ceiling.

After the bottom had been completely sanded to remove all old paint, the resin was applied to a small area. Then the fiber glass cloth was pressed against the resin-covered area and a coating of resin applied over it. This operation was repeated until the entire boat bottom had been covered with one layer of cloth and two of resin. Then a second and third lamination was done in the same manner.

The cloth is 0.015 in. thick and the complete new covering of three laminations is only 3/16 in. thick. Total weight for the new covering is estimated at 120 lb, about 12% of the extra weight usually collected through water absorption.

Thirty yards of glass fiber cloth were used in each lamination, making a total of 90 yd for the entire project. The cloth was obtained from Kristal Kraft, Inc. It is made from fibrous glass yarn produced by Owens-Corning Fiberglas Corp.

The glass fiber-resin covering was placed on the deck and cabin top of the other cruiser for waterproofing purposes. In this case the original canvas covering had deteriorated until it was no longer useful.

This wind tunnel wind mouth was economically produced as a spinning.

Spun Metal Shapes Meet Tough Requirements

Spinnings are finding increased use, especially where limited numbers of huge parts are required.

by **HERBERT EDLUND,** Vice-President, Roland Teiner Co.

● Metal spinning has long been the solution to the production of symmetrical metal items where re-entrant contours and a good finish are desirable, and where the limited number required would make the cost of dies prohibitive. Advances in aero-dynamics, television and many other fields of late are making increasing use of huge parts, and the importance of metal spinning is increasing correspondingly.

Metal spinning is the shaping of a revolving piece of metal in a lathe by means of pressure applied with a blunt tool. The metal flows into shape and cutting is not generally employed. Compared to the tooling necessary for press work, the required chucks and implements can be produced with comparative ease and often at a cost 10 to 15% less. Metal spinners can get into production within a few days, where the installation of drawing dies would take weeks and even months. It is also possible to obtain closer tolerances on small job lots, a more mirror-like finish and a greater variety of contours. Spinning is particularly effective where five or ten sets of stage dies would be required, which is frequently the case in the aircraft industry. The larger the part, the more magnified are the advantages of metal spinning.

Spinnable Metals

Most of the common metals including aluminum, carbon and stainless steels, iron, copper, nickel and zinc can be shaped by spinning. Stainless steel is probably the most frequent spun metal, but it is also the hardest owing to its low ductility and work hardening characteristics. Ten gage is regarded as the most practical, but stainless steel of the straight chromium type containing 17% chromium is not particularly well adapted for this purpose. The best results are obtained from a chromium content of 12 to 16%. The 18:8 stainless steel is also well adapted to spinning, but in this case, there is rapid work-hardening and a number of annealing treatments may be required. This work-hardening tendency, however, can be reduced by a higher nickel content and this frequently permits two or three times as much deformation before annealing becomes necessary.

Copper and copper alloys such as commercial bronze and red and yellow brass are common spinning materials. Electrolytic tough pitch copper is widely used for electrical appliances because of its heat conductivity. Generally speaking, preference is given to soft temper sheet stock annealed to grain size between 0.15 and 0.30 mm. Room temperature spinning of these metals is restricted to shallow parts, but heat may be applied either to the metal or the chuck with spinning temperatures approaching 600 F.

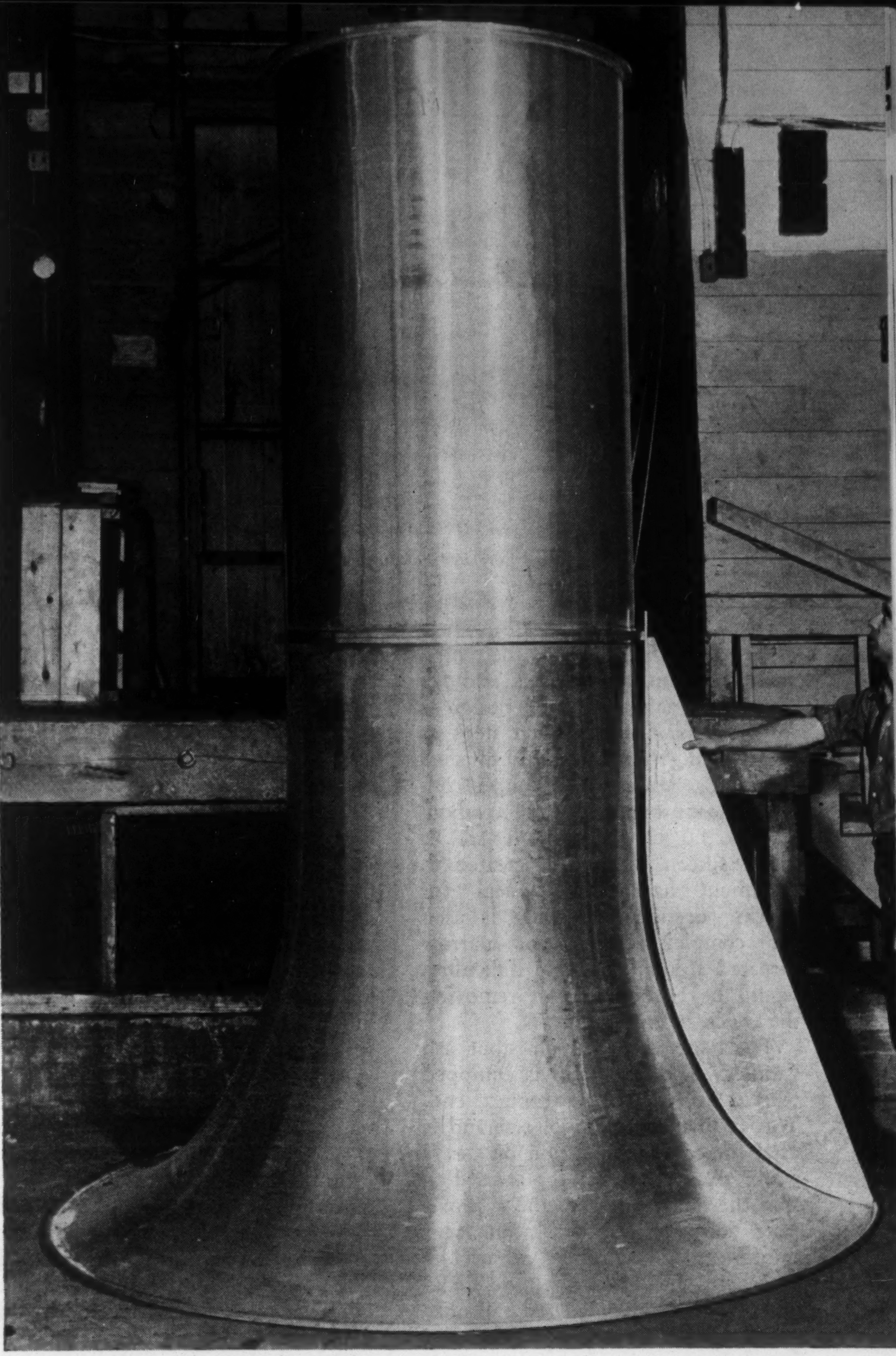
Zinc and zinc alloys can readily be spun without annealing, but difficulty is sometimes experienced when temperatures fall below 70 F. In such cases, it is sometimes advantageous to immerse the part in boiling water.

Sizes and Shapes

There is apparently no limit to the size and thickness of metal which can be spun other than the power and strength of the lathe and tools. Steel tank heads have been spun to a diameter of 21 ft 6 in. and 1-1/16 in. thickness from blanks 276 in. in dia weighing 10 tons. To accommodate such large work, the bed of the lathe is cut away to increase the swing capacity.

It is customary in spinning cones of 6 ft in dia or more to form a lip by rolling over the outer edge by means of a wooden tool. This stiffens the blank and prevents vibration and whip. The metal disk is gripped between the chuck and a large flat ball bearing center. The tailstock is drawn up tight so that the metal will not slip under pressure. The chucking is made with a calculated springback and in most instances, the work is laid down with long powerful strokes. Re-working over the same area is avoided especially with materials having a high rate of work hardening. Tool friction is often reduced by putting a flash copper plate on the material to be spun. In working with aluminum, embossed ridges can readily be spun as close as 1/16 in. from each other and changes in contour of 90 deg are quite common.

Large spinnings are polished on a turntable machine. The work is bolted or clamped to the table which is rotated at required speeds. The operator polishes the surfaces by a handle bar equipped belt grinder suspended overhead from a chain block. The turntable can be tilted 45 deg in two directions, giving the operator access to all parts of the work.



Inlet orifice, 87 in. o.d. and 121 in. high, was spun on one of largest lathes used for metal spinning.

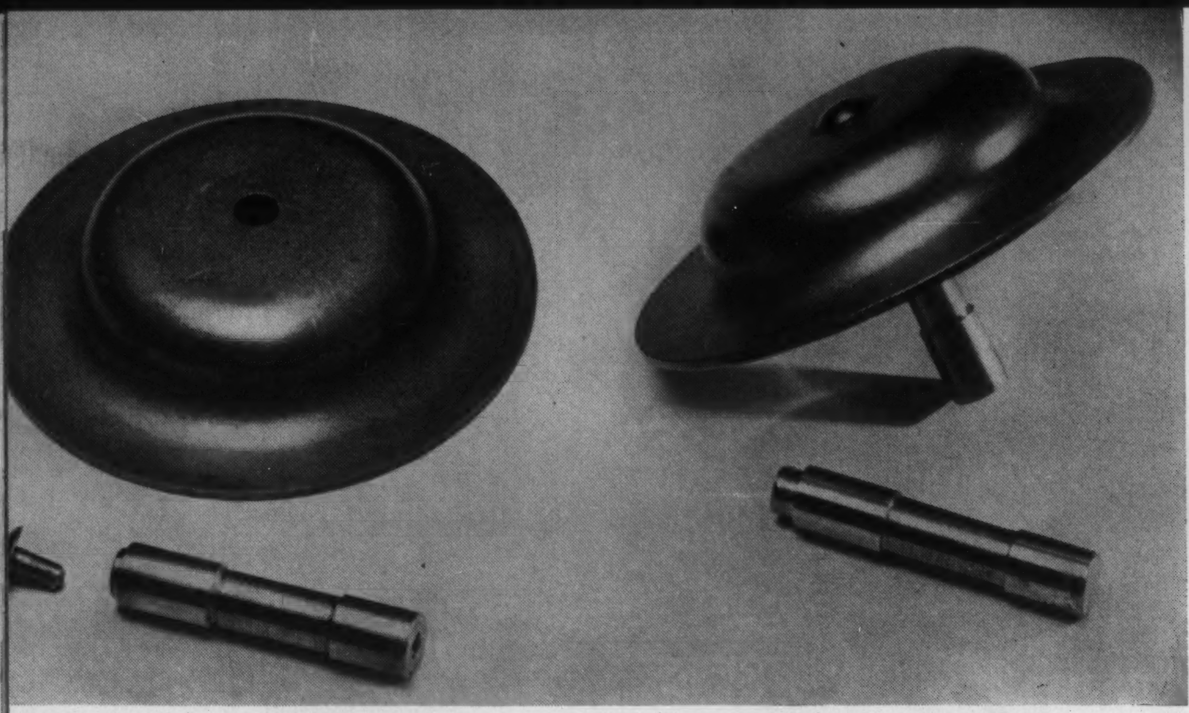
Usually the finished piece of metal spinning has the same diameter as the original blank, but the thickness is reduced because of the metal flow. Reduction may be as much as 30%. Tolerances of 0.005 in. have been obtained, but it is more practical not to specify tolerances closer than 0.020 in. for aluminum and 0.015 in. for other metals. Commercial tolerances of 1/16 in. are general for large work.

Steps in Metal Spinning

Generally speaking, there are three major operational phases in metal spinning. The first is called the breaking down. This consists of shaping the metal to an approximation of its final shape and about 95% of the deformation is carried out in this phase. In this step, the metal is "spun on air" for there is no support in back of the metal.

The second step is referred to as the laying down process. The metal is shaped to the chuck and conforms accurately to the shape of the mold. The third step is the planishing and entails the removal of tool markings.

Form blocks are generally made of kiln-dried maple, but chucks may also be made from iron or steel and sometimes aluminum or masonite blocks. Wood chucks are usually made from blocks of rough wood built up in layers of 13/16 in. hardwood. These



Spinning was used here to form button at top of assembly (right).

are subject to humidity and thermal changes. Steel chucks are almost essential for working the high strength spinning materials and for softer materials where the design is intricate and involves such steps as breakdown, cupping and finished spinning. An alloy cast iron containing approximately 3.0 carbon, 2.5 to 3.0 chromium and 1.2 to 1.5% silicon when heat treated to maximum hardness is ideal for chucks. Sectional chucking is used for complex designs or narrow throated spinnings where difficulties would be encountered in removing the chuck in one piece.

Tools are mounted on stout ash handles. The lever tool is equipped with a roller on the contact end. This is pivoted to a tool rest and is used for compound action on heavy work. A secondary lever is used to spin the metal down to the approximate form of the chuck on large spinnings. The roller is usually made of high carbon steel and sometimes is chromium plated. Bronze spinning tools are frequently used for the spinning of stainless steels inasmuch as alloy steels sometimes result in a welding action during the spinning. Broader and flatter tools are used on Inconel, monel and nickel to distribute the plastic flow over a greater area and to reduce overstrain.

Much of the success in spinning depends upon the proper use of lubricants. The ideal lubricant should be heavy in body to withstand high pressures and temperatures. It should also be easy to clean which is accomplished by spray rather than the older method of batch immersion. Tallow, vaseline, lard oil, or mineral oils in various combinations are commonly used for aluminum alloys. Lard oil, soap, beeswax, or paraffin are all satisfactory for use on copper and copper alloys. Oil-bearing lubricants are used for heavy stainless steels with yellow laundry soap or white lead and linseed used for lighter gages. The latter is excellent but hard to clean. Lubricants containing lead or sulfur should be avoided if the spun part is to be annealed to present embrittling.

When annealing becomes necessary between the spinning steps, the part is removed from the lathe and placed on a carriage with a heat resisting alloy tray. A gas-fired furnace with a hearth area of about 84 in. sq and capable of maintaining temperatures up to 2500 F is generally used for this purpose. The spun part is uniformly heated and cooled by a stream of air from a man-cooler type fan.

In the case of stainless steel, the spun part must first be pickled in nitric acid if copper, brass or copper alloy tools have been used in the spinning, for even minute traces of copper will cause cracking in later spinning. This pickling is performed in a carbon, block lined tank equipped with hinged cover, hood and exhaust for fume removal. The solution is heated usually by means of steam coils. It is important that the spun stainless steel shells be handled with clean gloves to prevent grease smears or finger prints which may burn into the surface during annealing.

Applications

Metal spinning is particularly adapted to experimental work. It is often possible for a good spinner to make adjustments to conditions and problems which could not have been foreseen before actual experience pointed them out. Ingenuity of the craftsmen often solves problems which would be disastrous if discovered after dies had been made.

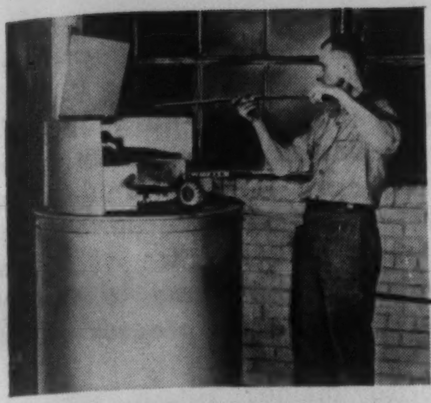
Recently, the Roland Teiner Co. was asked to spin an orifice with a large diameter of 68 in. The specifications called for a flange to be welted on the end, but it was found that the heat from the welting would distort the roundness of the piece. By comparatively simple redesigning, the end was spun back so that the part was made entirely of one piece, yet strength of spin-back compared favorably with flange strength.

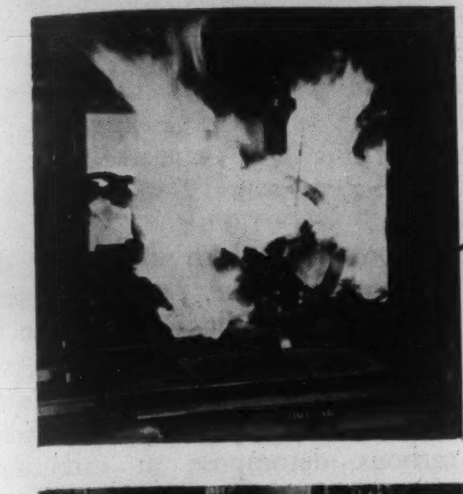
This firm also spun an inlet orifice for Curtis-Wright. The piece had an overall height of 121 in. with an o.d. of 87 in. This was spun with 3 SO aluminum, 1/8 gage, on one of the largest metal spinning lathes in the country. While the part was spun with little difficulty, the tailstock could not be pushed out of the way so that the piece could be removed from the chuck without distortion. This was solved by unbolting the chuck from the headstock while the spinning was still on it and swinging it from the lathe by a chain hoist.

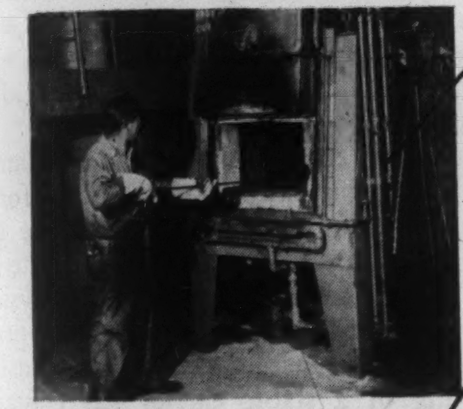
One unusual project, recently reported, was the spinning of flanged dished heads from 1/2 to 5/8 in. wrought iron in diameters of 48 and 66 in. This was accomplished by heating the blanks to 1450 F and spinning them until they cooled to 1100 or 1150 F whereupon they were re-heated and spun again. In this case, the roller was played over a large area to avoid accentuating localized stress.

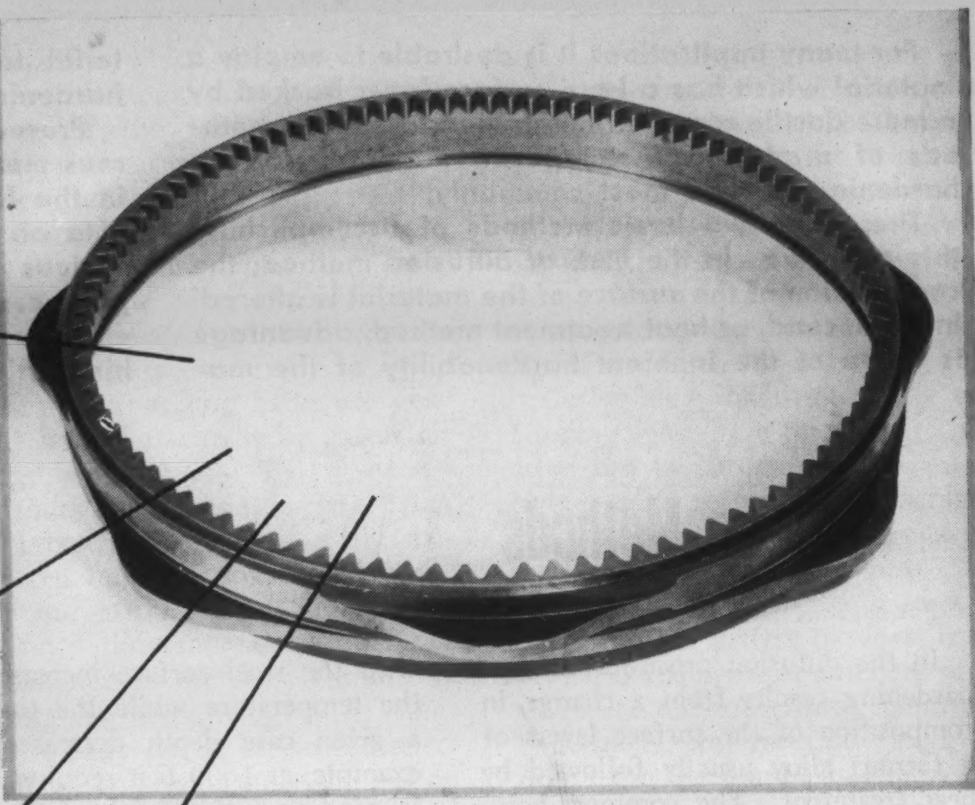
A combination of spinning and fabrication is a frequent solution to many design problems. Recently the problem of producing a Cadillac hub cap was solved in this way: Volume production was eventually to be achieved with tooling costs running into several thousands of dollars. In order for manufacturers to better visualize the problems involved in the design, four samples were first spun in type 304 stainless steel at relatively low cost so that all complications could be accurately anticipated before the expense tooling was undertaken. This resulted in an overall cost reduction.

Another example of collaboration between metal spinners and die workers occurred in the production of aluminum corona shields used for high-powered long-wave radio stations. Two halves were spun to form a doughnut shaped piece, 48 in. in dia of 11 gage aluminum. These halves were then welded together and the welts smoothly ground. Tubular supports were then flattened on one end for bolting to the press work assembly.









A number of different methods are available for surface hardening parts.

Surface Hardening of Steels and Irons

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This is another in a series of comprehensive articles on engineering materials and their processing. Each is complete in itself. These special sections provide the reader with useful data on characteristics of materials or fabricated parts and on their processing and applications.

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Surface hardening is used to produce a hard surface backed by a more ductile core. There are a number of common processes for selectively hardening steels, the most suitable method for a definite application depending on the characteristics desired in the case. This Manual discusses selection factors, and the characteristics and applications of the following methods:

- ***Carburizing***
- ***Nitriding***
- ***Cyaniding and Carbonitriding***
- ***Flame and Induction Hardening***

For many applications it is desirable to employ a material which has a hard surface layer backed by a more ductile core. Although there are other methods of producing a composite material, surface hardening is used most commonly.

There are two basic methods of accomplishing this objective. In the first, or diffusion method, the composition of the surface of the material is altered. In the second, or heat treatment method, advantage is taken of the inherent hardenability of the material to produce a hard surface by preferential hardening.

Procedures used in the surface hardening of ferrous metals by the common methods are discussed in the following sections. Information is included also on the alloys suitable for hardening by the various methods, the characteristics of the cases produced and typical applications to assist the engineer in the selection of the process which fits his particular requirements.

Diffusion Methods

In the diffusion processes, surface hardening results from a change in composition of the surface layers of a ferrous alloy usually followed by heat treatment. The common processes covered in this manual depend on increasing the carbon content (carburizing), the nitrogen content (nitriding) or both (cyaniding and carbonitriding). These methods are discussed in the following sections and a comparison of the types of cases produced is included in a table.

Besides these methods there are a few others which involve diffusion or impregnation of the surface with elements other than carbon or nitrogen, such as silicon (siliconizing), chromium (chromizing), and aluminum (calorizing). These processes are not included here because their uses are still specialized and relatively small.

Carburizing

The ASTM defines carburizing as "A process of case hardening in which carbon is introduced into a solid iron-base alloy by heating above the transformation temperature range while in contact with a carbonaceous material which may be a solid, liquid or gas."

In both the solid and gaseous carburizing procedures, carburizing depends on the reaction of a gas with the steel surface to release carbon, which may be either absorbed in the steel or appear on the surface as soot. The carbon that is absorbed by the steel diffuses inward, the rate depending on such factors as the temperature, the diffusion coefficient and the carbon potential at the surface. The temperature is the most important variable in the process. Diffusion rates, carbon solubility in the austenite and rate of reaction with the steel surface increase with the temperature while the time for a given case depth decreases. For example, at 1600 F it requires 16 hr to produce a case depth of 0.060 in. in a salt bath. At 1700 F the same depth of case can be obtained in 6 hr.

Pack Carburizing—Pack or box carburizing is practiced, as its name implies, by placing the work to be carburized and a solid carburizing compound into a box, sealing the box and heating it in a suitable furnace to the required temperature. Generally, the carburizing compounds are based on hard wood charcoal or coke containing carbonates as energizers. Athough both batch and continuous furnaces are used, the principal requirement of a furnace is the ability to maintain a uniform temperature for the required time. Temperatures range generally from 1550 to 1750 F, the time varies from 3 to 70 hr and the depth of case from 0.025 to 0.25 in. After carburizing the parts can be cooled in the box or removed from the compound and quenched.

Because of the slow rate of heating and the impossibility of raising the entire contents of the box uniformly to the carburizing temperature warpage is a problem and it is difficult to obtain uniform thin cases. The method is seldom used for the production of cases less than 0.025 in. in depth, the lower limit generally being about 0.040 in. It is necessary also, in ordinary box carburizing, to specify fairly liberal case depth tolerances, for it is difficult to hold to less than 0.010 in. variation in depth of case throughout the box.

Gas Carburizing—In gas carburizing the steel is heated in contact with carbon monoxide and/or a hydrocarbon which is readily decomposed at the carburizing temperature. This hydrocarbon can be methane, propane, natural gas, vaporized fluid hydrocarbon or a similar material. The higher hydrocarbons decompose at carburizing temperatures into methane, soot and hydrogen and therefore all react in essentially the same manner after decomposition of the soot.

The composition of the carburizing gas is extremely important for it influences the rate at which the gas reacts to supply carbon, the rate of formation of soot and the physical nature of the soot. In modern practice, a prepared gas is used consisting of a stable carrier gas containing a relatively unstable carburizing gas in suitable dilution to provide carbon at the steel surface at the desired rate without excessive sooting. The carrier gas also serves to purge the furnace before admission of the carburizing gas and to maintain the desired pressure. Either batch or continuous furnaces are used, generally with forced circulation. To exclude air, these furnaces are operated with a positive gas pressure.

An important advantage of gas carburizing is the fact that the composition of the gas and the rate of flow can be adjusted to obtain the desired carbon content and depth of case. Other advantages include adaptability to large volume production and to the carburizing of small parts and low labor costs in comparison with the pack method. Disadvantages include the requirement of technical personnel to supervise the operation and the necessity for atmosphere control at regular intervals.

Liquid Carburizing—In all liquid carburizing baths operated commercially, the carburizing medium consists of cyanides together with an activating agent. For cases of moderate depth up to 0.040 in., they frequently contain barium compounds as activators although phosphates, fluorides, fluosilicates or acidic oxides are used if water-soluble materials are desired for ease of removal from the surface.

For heavy cases, liquid carburizing baths usually contain barium catalysts and an average cyanide content of 8 to 12% although the use of water-soluble baths is increasing. These baths operate generally in the range 1700 to 1750 F and are used for the production of cases in the range 0.030 to 0.100 in. in depth usually although deeper cases can be produced.

There is some disagreement on the manner in which carburizing proceeds in the liquid bath. It appears however that the basic reaction is the oxidation of a cyanide to a cyanate by air followed by decomposition of this cyanate to yield nitrogen and carbon. The barium activator also enters the reaction by forming barium cyanide which decomposes and supplies additional carbon. Primarily because of the high temperatures employed the case formed in these modern activated baths resembles that formed in gas or pack carburizing more nearly than the cases formed in the plain cyanide baths which are operated at lower temperatures with no activators.

Liquid carburizing baths are generally heated externally by gas or oil firing or internally by immersed electrodes and range in size from small batch-type pots to fully mechanized units for mass production.

Liquid carburizing is quite flexible since different case depths can be obtained in the same furnace by varying the carburizing cycle. Similarly, a piece can be carburized selectively by immersing only the section to be carburized. Sometimes liquid carburizing can be combined with other operations since parts can be transferred using the same fixtures. Thus, special heat treatments such as martempering can follow the carburizing cycle. Among other advantages are freedom from sooting and oxidation problems. Disadvantages include: (1) parts must be thoroughly washed after treatment to prevent rusting, (2) regular adjustment of the bath composition is necessary to obtain uniform case depth and (3) some shapes cannot be handled either because they float or will cause excessive dragout of salt.

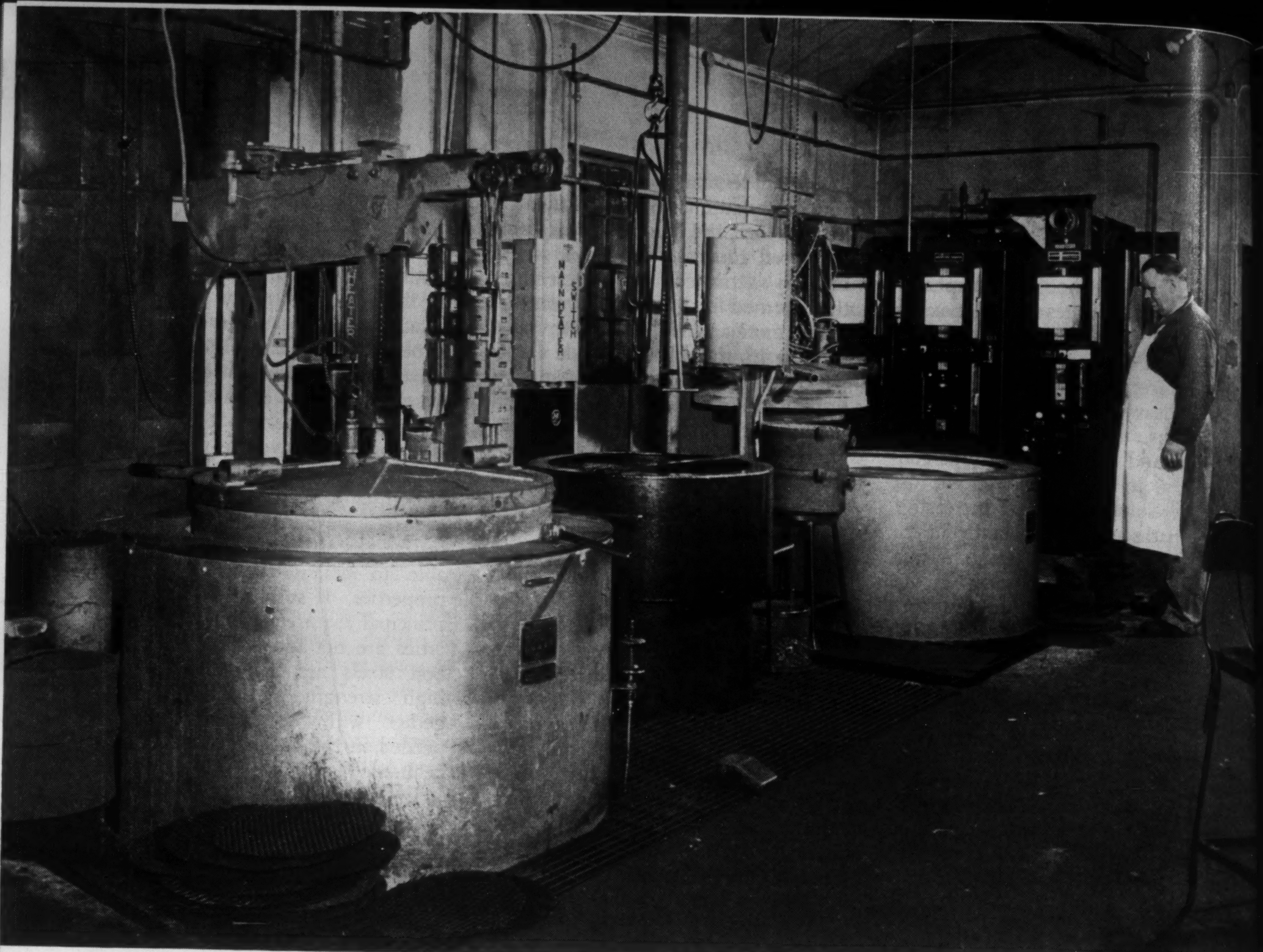
Carburizing Steels—Steels for carburizing must have the proper characteristics to permit them to absorb carbon at a reasonable temperature and rate, be hardenable without excessive distortion and be heat treatable to obtain the required core properties. If surface hardness is the principal requirement and core properties are not too critical, plain carbon steels are generally used. If high strength and toughness together with deep hardening are needed in the core, alloy steels must be used.

In the selection of plain carbon steels, those of the AISI 1000 and 1100 series are generally employed with the carbon content held to a

Comparison of Methods

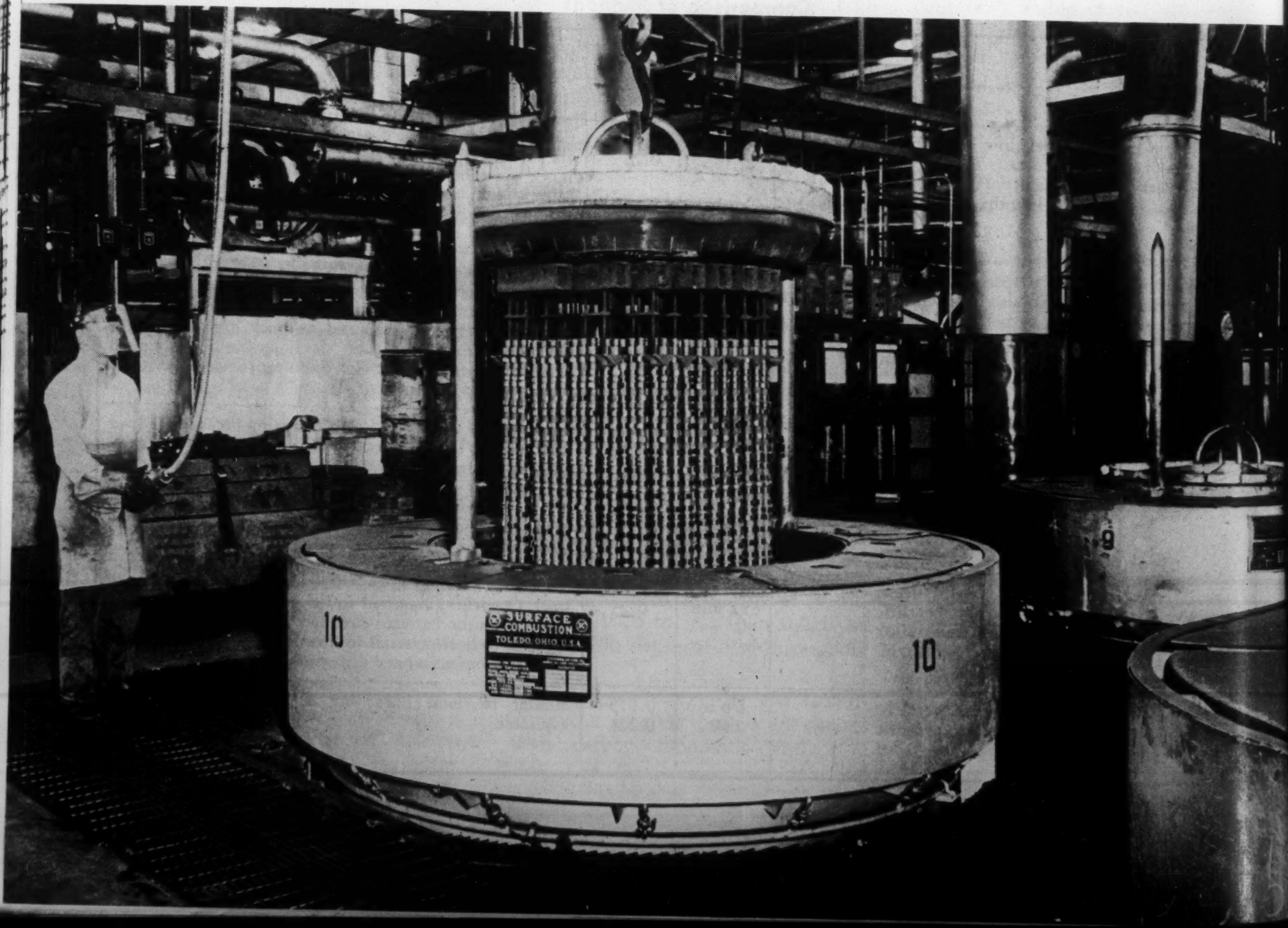
Process	Steels	Typical Conditions			Remarks
		Temp, F	Time, Hr	Case Depth, In.	
Carburizing (Refer to text for differences in pack, gas, and liquid methods)	Any steel low enough in carbon to take up that element readily. Usual steels contain less than 0.40% C.	1450–1750	½–70	0.005–0.25	Carbon content can be controlled throughout case. Warpage a factor because of high operating temperatures. Work must be quenched to develop full hard surface. Most widely used method.
Nitriding	Primarily special nitriding steels: can also be used with medium carbon AISI steels containing Cr and Mo and for stainless steels, some cast irons.	930–1050	Up to 100	0.005–0.030	Since low temperatures are used and no quenching is required, distortion is minimized. Wear resistance and fatigue resistance are outstanding characteristics of nitrided case. Hardness retained to much higher temperatures than in carburized cases. Maximum hardness obtained only with special steels. Corrosion-resistance of stainless steels reduced by nitriding.
Cyaniding and Carbonitriding	Same steels as used for carburizing.	1200–1600 F	¼–4	0.003–0.020	Warpage less serious than in carburizing because of lower temperature. Quench required for full hardness generally but use of low temperature range results in increased nitrogen content and yields file hardness without quenching. Can usually oil-quench steels and can use carbon grades instead of alloy grades where core property requirements permit.
Flame Hardening	Medium carbon AISI steels, gray iron castings, pearlitic and nodular cast irons, alloy cast irons, hardenable stainless steels.	*	Few sec. to a min.	0.06–0.25	Maximum hardness in case depends on carbon content of steel. Quenching required to harden steel. No sharp line of demarkation between case and core. Only few seconds required to heat material to quenching temperature. Scaling, decarburization and distortion minimized.
Induction Hardening	Medium carbon AISI steels; gray iron castings, pearlitic malleable and ductile irons.	*	Up to 2 sec.	0.015–0.125	Similar to flame hardening. Fastest heating method available.

* *Above transformation range of ferrous alloy being hardened.*


MAIN HEATER SWITCH
HEATER

Gas carburizing of aircraft gears with carbon control.

Gas carburizing furnace being loaded with a charge of camshafts.


SURFACE COMBUSTION
TOLEDO, OHIO, U.S.A.
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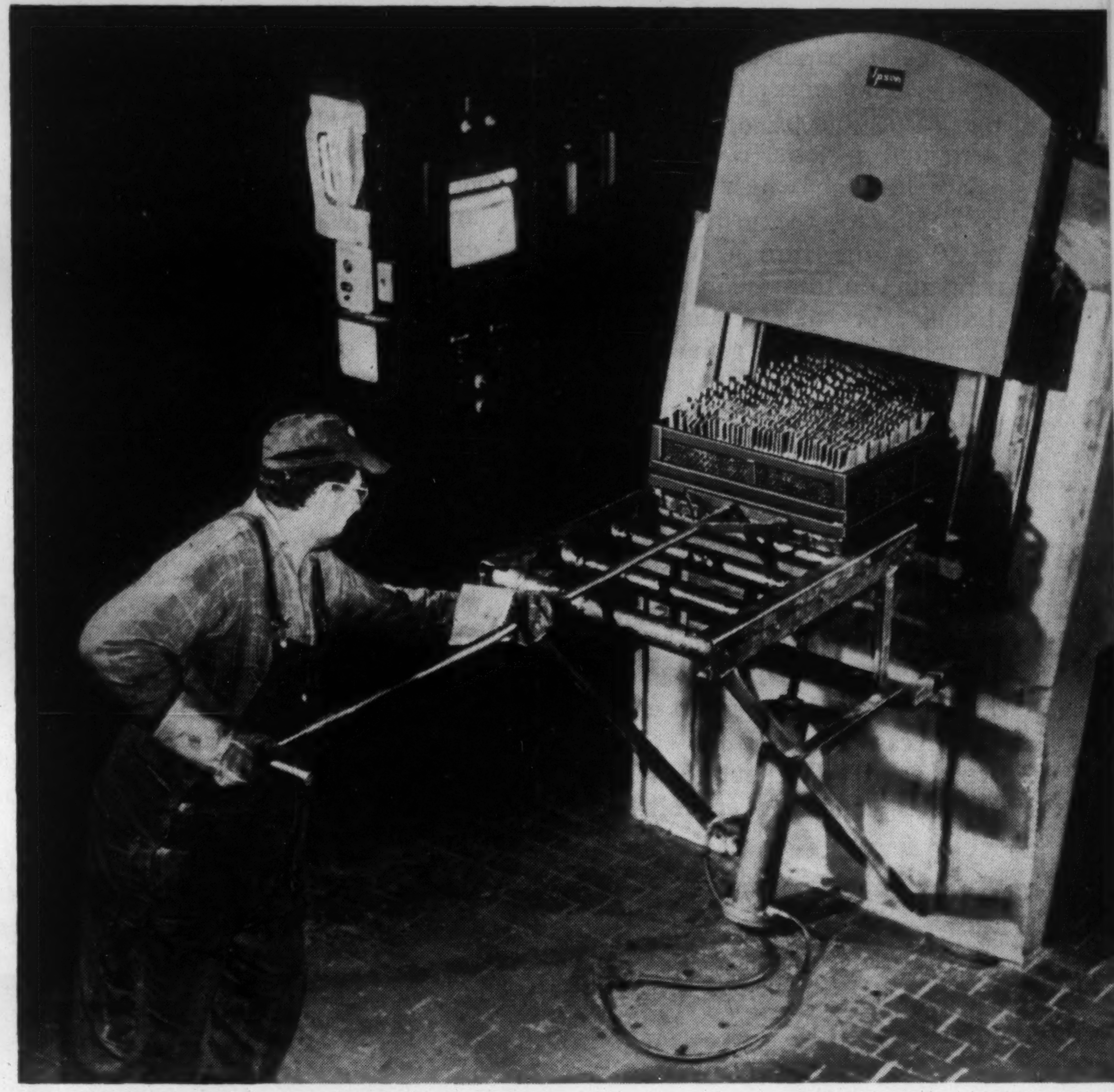
maximum of 0.25%. Moderately alloyed steels containing up to 2% alloying elements are selected frequently for applications where oil-hardening is one of the requirements. Among the more commonly used steels in this group are the AISI 3100, 4000, 4100, 4600, 5100, 6100, 8000, 8600 and 8700 steels. AISI 4615 is probably the most popular alloy carburizing grade. Carbon content may range up to 0.45% although for fine grained steels, 0.25% carbon is preferable as the upper limit. In the more highly alloyed steels, the AISI 2300, 2500, 3300, 4300, 4800 and 9300 steels are employed with the carbon content limited generally to a maximum of 0.25%. To obtain optimum hardenability in boron steels special precautions are necessary to control carbon concentration in the case. To minimize distortion, quenching must be closely controlled also.

Heat Treatment After Carburizing—A carburized steel has a duplex structure consisting of a high carbon case and a low carbon core. Since the addition of carbon to iron lowers the transformation temperature range, the case can be hardened at a lower temperature than the core and a considerable variation of case and core properties is obtainable by using different heat treatments.

Direct quenching from the carburizing furnace is popular because it is the least expensive and distortion is reduced when a single quench is used. However it is sometimes desirable to cool the material slowly in order to permit machining operations before hardening. Following slow cooling a variety of heat treating procedures can be used to obtain the desired combination of case and core properties. (*For additional details on carburizing, refer to Manual No. 87, in* MATERIALS & METHODS, *Oct., 1952*).

Nitriding

Nitriding is a means of case-hardening certain alloy steels by treating them with ammonia or other nitrogenous material. The process depends for its effectiveness on formation of nitrides in the steel by reaction of nitrogen with certain alloying constituents. To accomplish this objective, a nitride forming element must be present and nitrogen must be supplied to the surface in active form. Molecular nitrogen will not react.



Gas carburizing followed by martempering produces hard conveyor belt links with low distortion.

Salt bath carburizing can be used to harden selective areas.

In the most widely used process, the steel is exposed to gaseous ammonia at a temperature suitable for the formation of metallic nitrides. Although a closed container is necessary through which ammonia can be circulated, the principal requirement of the furnace is ability to maintain uniform temperature conditions for the required period. Temperatures are generally maintained in the range 930 to 1050 F and cycles of 12 to 100 hr are used although 24 to 48 hr cycles are most popular. Exposure of steel to ammonia in this temperature range results in decomposition of part of the ammonia into active nitrogen and hydrogen, part of the former combining with the steel to form nitrides while the latter passes from the furnace with the excess ammonia.

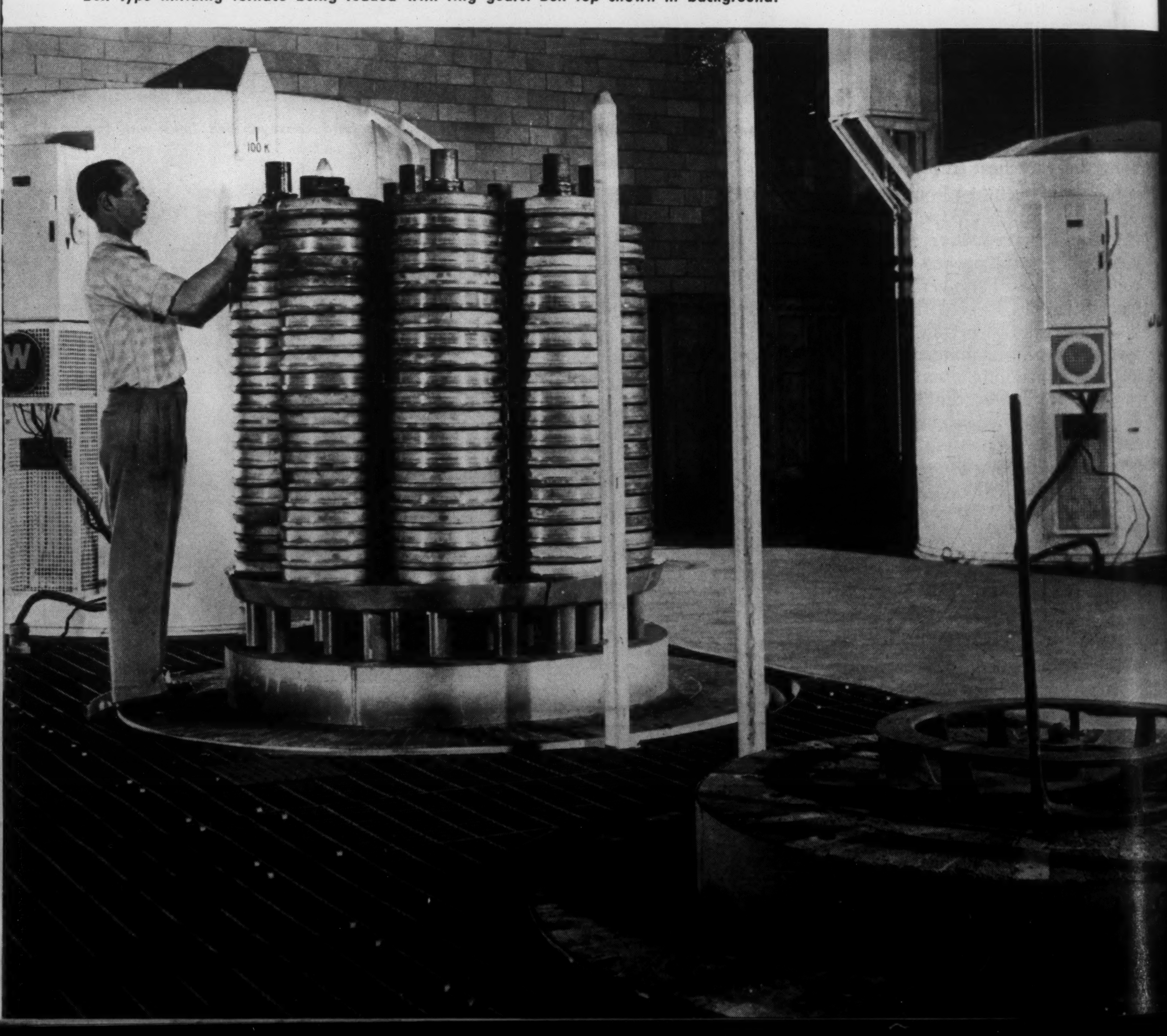
The case thus formed consists of two layers. The outer or "white layer" is composed entirely of nitrides of iron and those alloying elements which form nitrides. This layer is usually removed by grinding. The inner layer contains precipitated nitrides formed by diffusion inward of the nitrogen from the white layer and case depth depends on time of exposure to the nitrogen.

Floe has developed a modification of the process for applications where grinding off the white layer is undesirable or impractical. This is a two stage nitriding cycle. In the first, the ammonia dissociation is held to 20% for a period of 5 to 10 hr at 975 F. In the second, the temperature is raised to 1025 to 1050 F. The ammonia dissociation, which is critical, must be held to 83 to 86%. During the second stage, any white layer formed is removed by inward diffusion of nitrogen, leaving the final case practically free from white layer and ready for service. Increasing use is being made of this process for applications such as gear hardening where elimination of the finishing operation reduces cost considerably.

Another method of nitriding consists of heating the steel in a salt bath maintained in the same temperature range as that used for gaseous nitriding. Various salt bath compositions are used but all are based on mixtures containing alkali cyanides. This process is particularly advantageous for nitriding small lots of material and is used frequently for application of a thin case on tool steels.

Nitriding Steels—The principal elements which assist in formation of useful nitride cases are aluminum, chromium, molybdenum, vanadium, and tungsten. Case depth can be influenced however by other elements such as carbon, silicon and nickel. Although these elements do not form nitrides, they can reduce

Bell type nitriding furnace being loaded with ring gears. Bell top shown in background.



the rate of penetration of nitrogen. Carbon can also influence the type of case by forming carbides with such elements as chromium and removing them from the reaction. The content of alloying elements is also important in providing suitable core properties.

Hardest cases are obtained with aluminum-bearing steels such as the Nitralloys. These are generally medium carbon steels containing also chromium and molybdenum, the latter being particularly effective in preventing embrittlement which can occur in steels heated in the nitriding range. For some applications, lower hardness is acceptable and steels containing no aluminum are used. Among such steels are the medium carbon AISI-SAE standard steels containing chromium and molybdenum.

The stainless steels can be casehardened also by nitriding. A proprietary process known as Malcomizing is used widely. Straight chromium steels of this type are more readily nitrided than nickel-chromium steels although both are used. Stabilized grades should be used since nitriding is performed in the sensitizing range. Tool steels are also given a thin hard case by nitriding for certain applications.

Depth of case depends on the diffusion of nitrogen from the "white layer" into the region below and time and temperature have considerable effects. Thus, nitriding at 975 F will produce a deeper case than nitriding at 940 F in the same time. Depth depends also on the steel composition. Highly alloyed steels are penetrated less readily by nitrogen than those less highly alloyed and cases developed in stainless steels are shallower than those developed in the Nitralloys.

Hardness of the case depends on a number of factors. The lower the nitriding temperature, the harder is the useful case. Aluminum is the most effective element in promoting hardness. Cases produced in steels containing aluminum have hardness values in the range 1050 to 1150 DPN excepting that containing nickel (Nitralloy N) which ranges from 950 to 1050 DPN. Steels containing no aluminum have cases of lower hardness generally in the range 600 to 900 DPN.

Structure of the steel is also a factor and it is generally stated that the steel must be quenched and tempered to obtain a sorbitic structure. Since tempering temperature is usually 1100 to 1300 F, reheating in the 925 to 1050 F range required for nitriding causes no softening of the core. Satisfactory nitriding of steels having other structures has been reported, but free ferrite must be avoided or brittle cases result. Decarburization resulting from heat treatment will cause uneven hardness, brittleness and spalling in the case.

Properties—Since nitriding is performed at relatively low temperatures and no quenching is required, distortion is reduced to a minimum although some growth occurs. If allowance is made for growth, parts can be finished to close tolerances before nitriding. This is an advantage of nitriding over carburizing. Some complex parts which cannot be casehardened satisfactorily by carburizing can be nitrided without difficulty.

Wear resistance is an outstanding characteristic of the nitrided case and is responsible for its selection in most applications. The hardness of a nitrided case is unaffected by heating to temperatures below the original nitriding temperature. Substantial hardness is retained to at least 1150 F which is in marked contrast with a carburized case. The latter begins to lose its hardness at relatively low temperatures. Fatigue resistance is also a valuable feature. Tool marks and surface scratches have little effect on the fatigue properties of nitrided steels while notches which were formed before nitriding do not reduce the fatigue strength to an appreciable degree. Disadvantages of nitriding include the long treatment time usually employed, cost of the special alloy steels required if maximum hardness is to be obtained, and technical control required.

Although it is sometimes indicated that nitriding improves corrosion resistance of a steel, this is true only if the white layer is not removed. Corrosion resistance of stainless steels is reduced considerably by nitriding, a factor which must be considered when nitrided stainless steels are used in corrosive environments.

Cyaniding and Carbonitriding

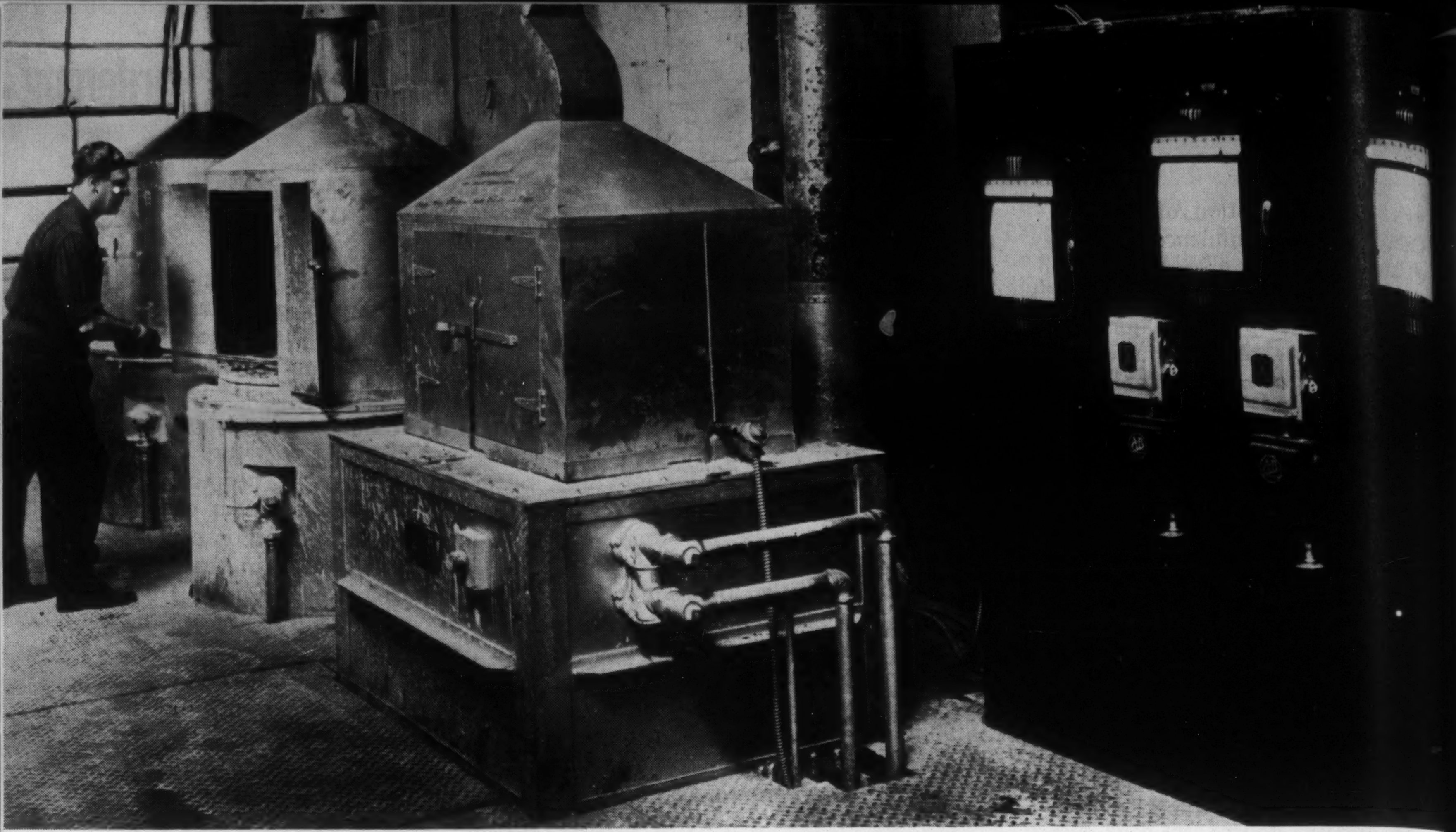
Cases containing both carbon and nitrogen are produced in liquid baths (cyaniding) and by the use of gas atmospheres (carbonitriding). Temperatures are generally lower than those used in carburizing, exposure is for a shorter time and thinner cases are produced.

Cyaniding — The proportion of nitrogen and carbon in the case produced in a cyanide bath depends on both composition and temperature, the latter being the most important variable. In baths operated at the lower end of the temperature range, nitrogen content is higher than in those operating at the upper end of the range. Generally, carbon content of the case is lower than that produced in carburizing, ranging from about 0.5 to 0.8%. However, the case also contains up to about 0.5% nitrogen and therefore file hard cases can be obtained on quenching in spite of the relatively low carbon content. The process is particularly useful for formation of thin cases. Among disadvantages of cyaniding are those mentioned under liquid carburizing.

Carbonitriding — Carbonitriding is a case hardening process in which a steel is heated in a gaseous atmosphere of such a composition that carbon and nitrogen are absorbed simultaneously. Since the process is actually a modification of carburizing rather than nitriding, choice of the term "carbonitriding" to describe it is rather unfortunate. Floe has suggested that nitro-carburizing would be more descriptive. It has also been termed Ni-carbing and dry cyaniding.

Various atmospheres are used for carbonitriding but they are essentially the same as those used in gas carburizing with the addition of ammonia to furnish the nitrogen required. The proportions of carbon and nitrogen absorbed in the steel are controllable to some degree by varying the composition of reacting gas although temperature is the most important variable. Absorption of nitrogen into the steel results in the formation of an alloy austenite which is stable at lower temperatures than that produced with carbon alone. Therefore, carbonitriding can be carried out at lower temperatures than carburizing. Transformation of austenite is also more sluggish and less drastic quenching procedures can be employed. Because of the low temperature treatment and oil-quenching rather than water quenching distortion is reduced. The less drastic quenching procedure also results in softer cores.

Temperatures for carbonitriding range from 1200 to 1625 F. As in



Cyaniding of screws, bolts and small parts yields thin cases at the rate of 200 lb per hr in these salt baths.

Clutch retainer plates, carbonitrided and quenched in automatic equipment, are ready for final inspection.

cyaniding, low temperatures favor high nitrogen content and high temperatures favor high carbon content. Time at temperature also affects the depth of case and usually a compromise set of conditions is used. In most commercial installations, a temperature range of 1500 to 1625 F is employed although in some continuous furnaces several temperature zones are used. If distortion is a major factor, the range 1250 to 1400 F is used as cases produced in this temperature range will air harden. The time varies from 15 min to 4 hr although occasionally treatment is extended beyond the latter figure. Cases produced are shallow ranging from 0.003 to 0.020 in. and are similar to those obtained in cyaniding under similar conditions.

Since nitrogen increases hardenability of steel, carbon steels can be substituted for alloy steels if the properties required of the core permit. This is stated to be one of the distinct advantages of carbonitriding. It is reported also that uniformity of hardness of the case is improved by carbonitriding, and in some carburizing installations small quantities of ammonia have been added to achieve this objective. Disadvantages include those given under gas carburizing.

Surface Hardening

Heat Treatment Methods

In these methods, structural changes are employed. Increase in hardness is achieved by quenching a hardenable steel from above the transformation range as in the usual heat treatment procedures. However, heat is applied to the surface so rapidly that only the surface layers are heated to the quenching temperature. After quenching, therefore, these layers are hardened while the core remains in the same condition as it was originally.

Two methods are in general use, flame and induction hardening. In flame hardening the surface of the piece is heated with a high temperature flame. In induction hardening, the temperature is raised by the resistance of the steel to the flow of induced electric currents.

Flame Hardening

The oxy-acetylene flame is generally used for flame hardening. Its temperature, which approaches 6000 F, quickly raises the surface of the steel to a temperature high enough to permit hardening by quenching. Propane, natural gas or mixed city gas are sometimes used instead of acetylene.

Flame hardening can be used on any steel which can be hardened by conventional methods. Depth of the hardened zone is controllable to a certain extent by an adjustment of flame intensity and heating time or speed of travel. A neutral flame or one slightly on the reducing side is generally used because it lessens the tendency for scale formation. The reducing flame uses the oxygen efficiently and has less tendency to overheat the work.

Skill is required in adjusting and handling manually operated equipment to avoid overheating the work because of the high flame temperature. Overheating can result in cracking after quenching and excessive grain growth in the region just below the hardened zone. Proper heating conditions can be judged by the eye. However machines incorporating a radiation device have been developed which can be used either to measure the surface temperature of the piece being hardened or to control the equipment. This feature has made the machines completely automatic where desirable. They are quite flexible and require less skill for their operation than manually-controlled equipment and are particularly advantageous for production line operations.

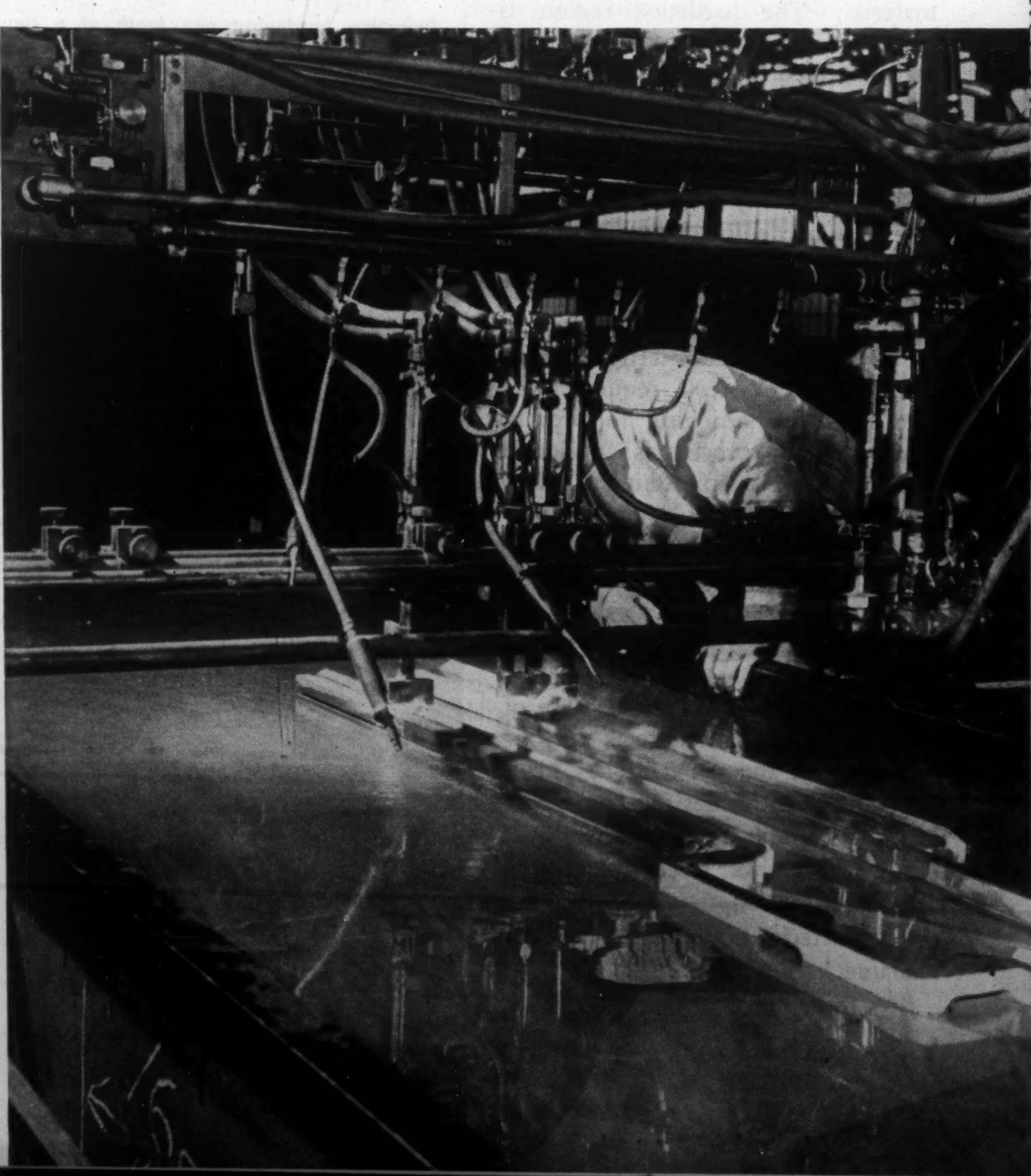
Four methods are in general use for flame hardening: 1) stationary; 2) progressive; 3) spinning and 4) progressive-spinning. In the first, both torch and work are stationary; in the second, the torch moves over a stationary work-piece; in the third, the torch is stationary while the work rotates; and in the fourth, the torch moves over a rotating work-piece.

The stationary method is used for spot hardening of small areas such as valve stems. The progressive method is used for hardening large flat parts generally but is also adaptable to the treatment of teeth of large gears. The spinning method serves to harden parts of circular cross section and is used for small precision gears, pulleys and similar components. The progressive spinning method also handles parts of circular cross-section particularly those, like shafts, which are considerably longer than their diameter.

In all procedures, provision must be made for rapid quenching after the surface has been heated to the required temperature. This may be accomplished by use of water sprays, by quenching the entire piece in water or oil, or even by air-cooling for some steels. After quenching, the part should be stress-relieved by heating in the range 350 to 400 F and air cooling. Such a treatment does not appreciably reduce surface hardness.

The maximum hardness obtainable depends on the carbon content of

Flame hardening of lathe ways prolongs the life of wearing surfaces.



Automatic flame hardening selectively hardens these camshafts.

the steel. Since there is no change in chemical composition during flame-hardening, there is no sharp line of demarkation between case and core. There is instead a gradual reduction in hardness from the surface to the original hardness of the material. The hardened region is generally several times as deep as that obtained in carburizing, ranging from ⅛ to ¼ in. in depth. Thinner cases of the order of 1/16 in. can be obtained by increasing the speed of heating and quenching.

Flame hardening is applicable to all hardenable steels. However, carbon and low alloy steels containing from 0.35 to 0.60 or 0.70% carbon are generally used. High carbon steels and tool steels require more care in flame-hardening to prevent cracking. The process is applicable also to the hardenable stainless steels, gray cast irons with combined carbon preferably in the range 0.50 to 0.80%, pearlitic malleable irons and nodular cast irons.

Fine grained steels are preferred. They should be stress-relieved before hardening if stresses exist because of prior working. The steels can be hardened in the conventional manner to obtain the desired core properties before surface hardening, if desired. However, steels heat treated to a tensile strength above 125,000 psi may crack if attempts are made to flame harden them.

Among the advantages of oxyacetylene flame hardening are adaptability and portability. The equipment can be taken to the job and adjusted to treat only the area which requires hardening. Parts too large to be placed in a furnace can be handled easily and quickly with the torch. The equipment is ready for almost instant use at any time. Another advantage is the ability to treat components after surface finishing since there is little scaling, decarburization or distortion. Disadvantages include the possibility of overheating and thus damaging the part and the difficulty in producing hardened zones less than 1/16 in. in depth. In manually operated equipment, case depth uniformity is not attained.

A modification of this flame hardening procedure employs a salt bath for the surface hardening of gear teeth. The gears are suspended from a suitable fixture and rotated with the teeth, only, immersed in the bath. This process differs from flame hardening because the bath is maintained at the desired temperature to which the part is to be heated. Since there is no temperature differential as in flame hardening, overheating cannot occur. Heating to quenching temperature requires several minutes after which the entire

Induction hardening one tooth at a time on an 82-in. ring gear. Only 18 min are required to harden 103 teeth.

fixture is quenched. Gears and sprockets hardened by this method are reported to be uniformly hardened and scale-free.

Induction Hardening

Induction hardening depends for its operation on localized heating produced by currents induced in a metal placed in a rapidly changing magnetic field. The operation resembles a transformer in which a coil surrounding the work is the primary and the piece being heated is the secondary. When an alternating current flows through the primary, a magnetic field is formed and currents are induced in the secondary. Heating results from the resistance of the metal to passage of these currents. Currents induced in a high frequency field tend to concentrate near the surface and therefore it is possible to heat a shallow layer of the steel without heating the interior. However, heat supplied to the surface tends to flow toward the center by conduction and therefore time of heating is an important factor if a shallow hardened zone is to be formed. It has been suggested that the heating should be controlled to limit the depth of heated zone to less than 1/5 the thickness of the piece to avoid heating the core. The surface layer is heated practically instantaneously to a depth which is inversely proportional to the square root of the frequency. Therefore, high frequency heating is generally employed for surface hardening. Since the time depends on power available from the converter, power together with frequency are the most important variables.

Three types of equipment are used for induction hardening: 1) motor-generator sets for relatively low frequencies; 2) spark-gaps for intermediate frequencies and 3) electronic tubes for high frequencies. Heating is rapid, being of the order of a few seconds.

In batch processes, temperature is generally controlled by automatically timing the cycle. In continuous processes, the speed of passage of the work through the coils is adjusted to obtain required temperature. Because these methods of temperature control are indirect, conditions producing the required case depth are generally determined by experiment. A radiation pyrometer has been developed recently which can be used to measure or control the actual temperature of the work and improve uniformity of hardening. As in flame hardening, provision must be made for rapid quenching of the part after it has reached the desired temperature.

The case obtained by induction hardening is similar to that obtained in flame hardening. Thinner cases can be obtained however because of greater speed of heating. Using minimum heating times it has been stated that a case depth of 0.040 in. is obtainable with a frequency of 10 kilocycles while a depth of 0.018 in. can be obtained by increasing the frequency to 120 kilocycles.

Steels used for induction hardening are similar to those used for flame hardening. Plain carbon steels of medium carbon content are used for most applications, particularly for production of thin cases. It has been determined that, in carbon steels, the carbon dissolves completely even in short time required to heat the steel to quenching temperature by induction. Maximum surface hardness obtainable depends on the carbon content. Alloy steels can also be induction hardened and are needed particularly for deep cases. Low alloy steels are readily surface hardened by this procedure but highly alloyed steels are more sluggish and may require an increase in temperature to achieve the desired structure for satisfactory hardening.

The structure of the material before hardening is particularly important in induction hardening because of the short time involved. It has been suggested that a sorbitic structure is most favorable for medium carbon steels while the presence of free ferrite is particularly objectionable if full hardness is to be obtained. Because of the rapid heating time, on the other hand, steel can be heated to temperatures from 100 to 200 F higher by induction hardening than by conventional methods without danger of excessive grain growth particularly in alloy steels.

Advantages of induction hardening include speed of heating, minimum distortion and freedom from scaling of parts. A further advantage is ability to fit the equipment directly into the production line and use relatively unskilled labor since the operation is practically automatic. Among disadvantages are cost of the equipment, a limitation on size of parts which can be handled economically, and high maintenance costs.

Selecting the Method

Selection Factors

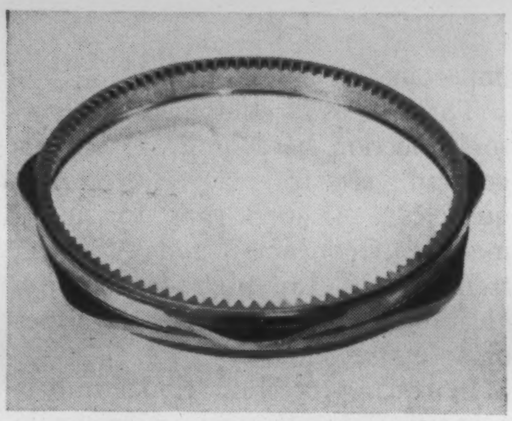
Selection of the optimum process for a given application depends on many factors. The stresses which must be sustained by the finished part are fundamental to the determination of the required core properties and case characteristics. For compressive stresses under static loads, the case must have sufficient depth and must be backed with a core strong enough to resist surface deformation. If bending stresses are involved, some hardness of the case must be sacrificed and the core properties must be modified to obtain optimum resistance to this type of stress. For resistance to abrasion, high case hardness with sufficient depth to give reasonable service life is necessary. Satisfactory functioning of the part also depends on such factors as metallurgical structure, gradation from case to core and condition and hardness of the surface. Selection is based to a large extent on experience with actual parts under service or simulated service conditions and a study of parts which have functioned satisfactorily or failed in service.

To assist in the selection of a suitable method, a brief recapitulation of the properties of the various methods follows.

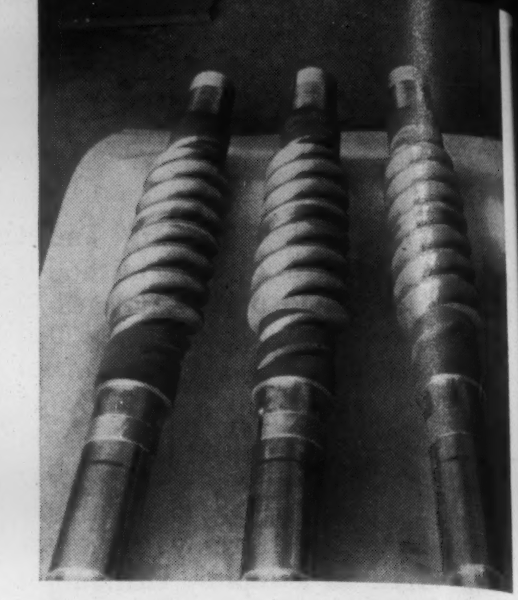
Carburizing

By choice of method and conditions, carburizing can be used to produce the widest range of case depths of any of the processes mentioned. Heat treatment is required to produce hard and wear resistant cases and distortion is a problem because of the high temperatures employed. The process is applicable to a wide range of carbon and alloy steels. Carburizing is still the most widely used of the surface hardening procedures.

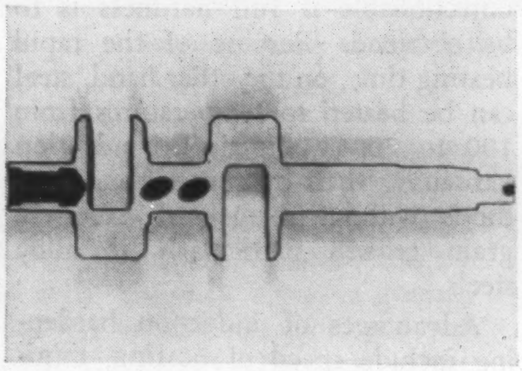
Applications of carburizing are legion. They include bushings for automotive and aircraft applications, crank and cam shafts, gears and pinions, machine parts shear and scissor blades.



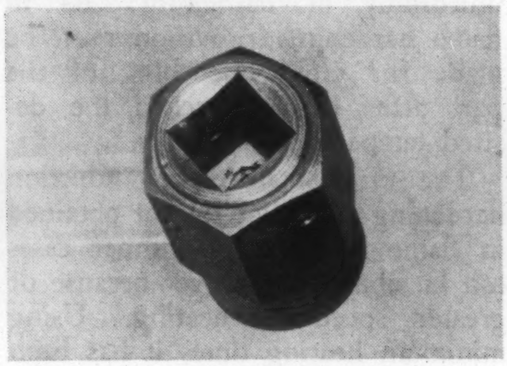
Part Rear intake and exhaust cam
Material AMS 6260 steel
Case Depth 0.055 to 0.065 in.
Method Gas carburizing
Atmosphere Cracked liquid
Temp 1700 F
Time 12 hr
Subsequent Heat Treatment
Hardened and tempered



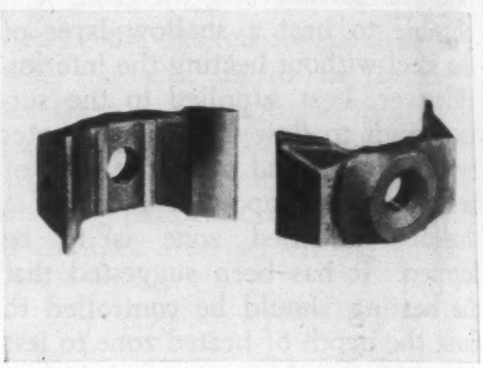
Part Worms
Material AISI 4620 steel
Case Depth 0.060 in.
Method Gas carburizing
Atmosphere Cracked liquid
Temp 1700 F
Time 8 hr
Subsequent Heat Treatment
Diffusion cycle used to produce case carbon content of 0.80% max; directly quenched into oil, tempered 3 hr at 400 F



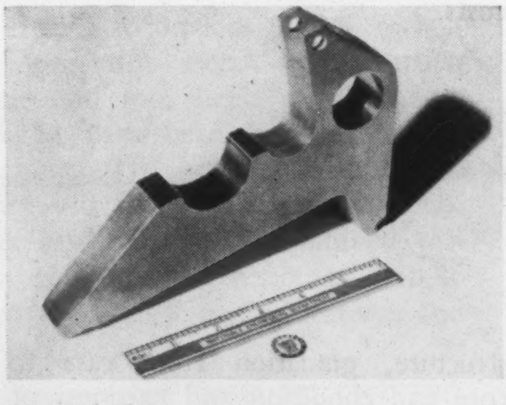
Part Outboard motor crankshaft
Material SAE 1022 in.
Case Depth 0.040 in.
Method Liquid carburizing
Temp 1750 F
Time 2 hr
Subsequent Heat Treatment
Martempering



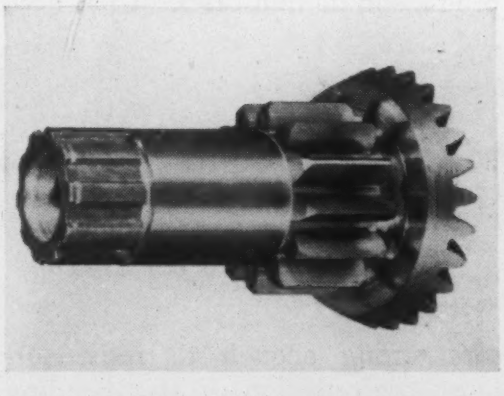
Part Stud wrench assembly
Material Cold rolled steel
Case Depth 0.005 in.
Method Liquid carburizing
Temp 1550 F
Time 15 min
Subsequent Heat Treatment
Quenched in brine, tempered 1 hr at 300 F



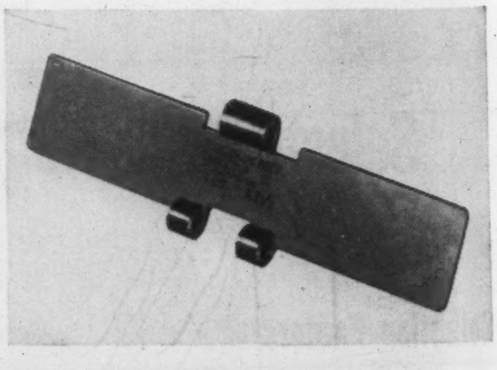
Part Governor body
Material AISI C1022 steel
Case Depth 0.050 in.
Method Pack carburizing
Temp 1700 F
Time 10 hr
Subsequent Heat Treatment
1425 F, for 5 min in lead pot, water quench, temper 1 hr at 350 F



Part Cam
Material AISI C1015 steel
Case Depth 0.045 in.
Method Pack carburizing
Medium Solid compound
Temp 1675 to 1700 F
Subsequent Heat Treatment
Quenched into water from 1400 to 1425 F



Part Heavy bull gear pinion for diesel tractor
Material SAE 8620 steel
Case Depth 0.045 to 0.050 in.
Case Hardness Rockwell C63 to C64
Method Gas carburizing
Atmosphere Prepared gas containing less than 1% ammonia
Temp 1725 F
Time 3 hr
Subsequent Heat Treatment
Furnace cooled to 1575 F, 55 min, quenched into oil at 150 F



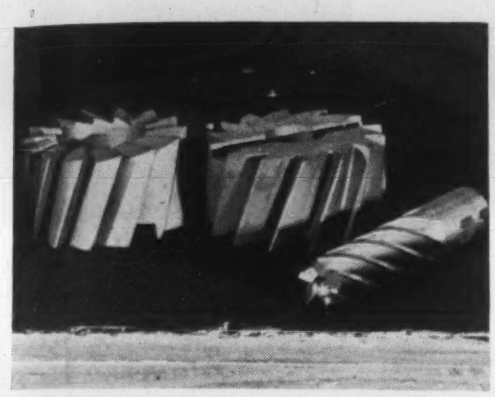
Part Link for conveyor chain
Material AISI C1018 steel
Case Depth 0.040 to 0.045 in.
Case Hardness Rockwell C62 to C64
Method Gas carburizing
Atmosphere Prepared gas
Temp 1700 F
Time 5 hr
Subsequent Heat Treatment
Quenched at 350 F in mar-tempering oil for 5 min at high flow and 15 min at low flow.

Nitriding

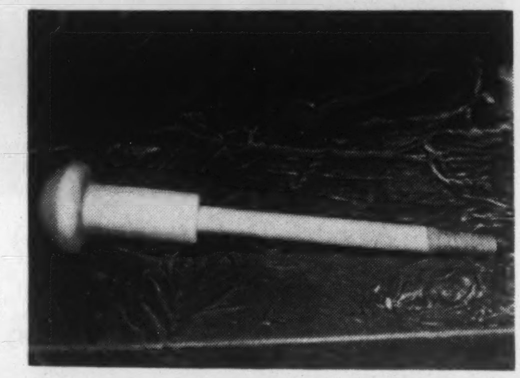
Nitriding is done at temperatures lower than those used for any of the other processes under discussion. Quenching is not required to obtain maximum hardness and therefore distortion is minimized. Steels can be heat treated to obtain desired core properties before nitiriding. Although some of the usual engineering alloy steels can be used, maximum hardness is obtainable only by using special alloy steels. The case produced by nitriding is harder than that produced by the other methods and has excellent wear resistance. Retention of hardness to at least 1100 F for long periods of time is a major advantage of the nitrided over the carburized case, for the latter begins to soften at relatively low temperatures.

Most applications of the nitrided steels are based on their resistance to wear, particularly toward sliding friction, or to fatigue. They are used in cylinder liners and barrels in aircraft engines, bushings, shafts, gears, piston pins, spindles and thread guides. Other applications requiring freedom from distortion include cams and cam shafts, rubber and paper mill rolls and boring bars.

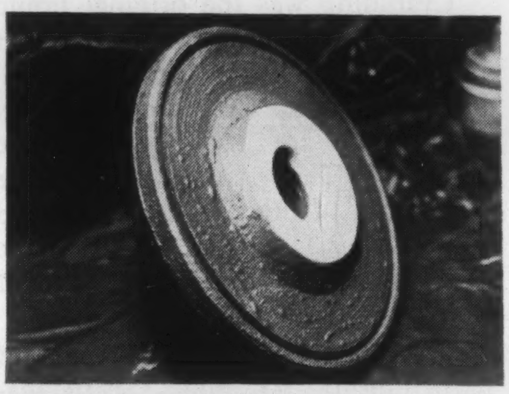
A 14 chromium, 14 nickel, 2.5% tungsten stainless steel is widely used for airplane valves, the stem being nitrided for increased wear resistance. High speed tools are nitrided to obtain a light hard case, which increases life greatly.



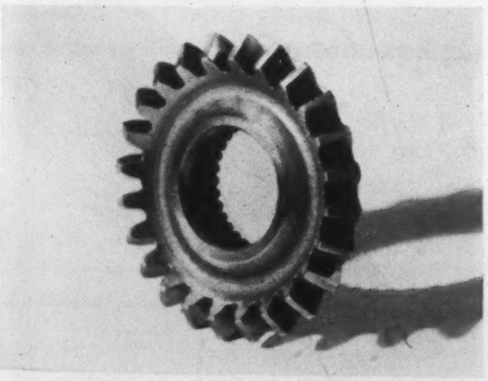
Part Milling cutter
Material Molybdenum steel
Case Depth 0.001 in.
Case Hardness Rockwell C63 to C64
Method Salt bath nitriding
  Temp 1000 F
  Time 25 min



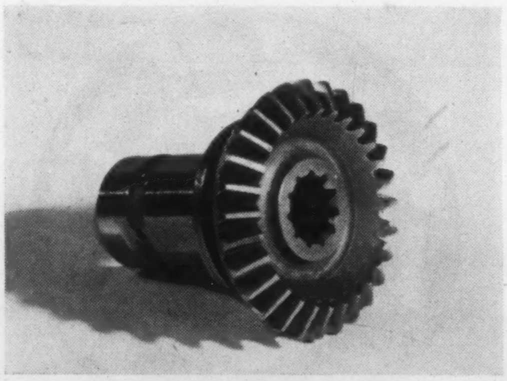
Part Steam turbine valve stem
Material AISI type 416 stainless steel
Case Depth 0.013 to 0.015 in.
Case Hardness Rockwell 15N 92 min
Method Nitriding by Malcomizing in commercial cycle
Remarks Threaded end is masked to prevent nitriding



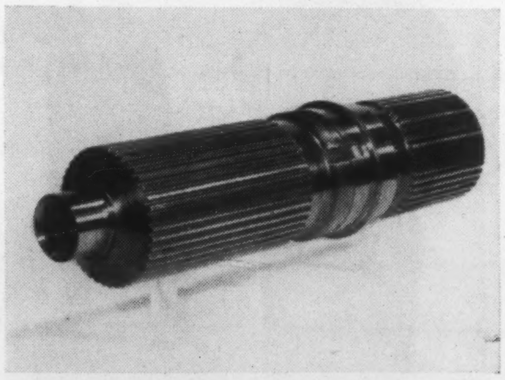
Part Steam turbine valve seat
Material AISI type 416 stainless steel
Case Depth 0.013 to 0.015 in.
Case Hardness Rockwell 15N 92 min
Method Nitriding by Malcomizing in commercial cycle
Remarks All surfaces excepting seat masked to prevent nitriding



Part Accessory Drive Gear
Material AMS 6470 (Nitralloy 135 modified) steel
Case Depth 0.017 to 0.022 in.
Method Gas nitriding (Floe process)
  First Stage
    Temp 975 F
    Time 8 hr
    Ammonia Dissociation 15 to 25%
  Second Stage
    Temp 1050 F
    Time 42 hr
    Ammonia Dissociation 83 to 85%



Part Oil pump drive gear
Material AMS 6470 (Nitralloy 135 modified) steel
Case Depth 0.017 to 0.022 in.
Method Gas Nitriding (Floe process)
  First Stage
    Temp 975 F
    Time 8 hr
    Ammonia Dissociation 15 to 25%
  Second Stage
    Temp 1050 F
    Time 42 hr
    Ammonia Dissociation 83 to 85%



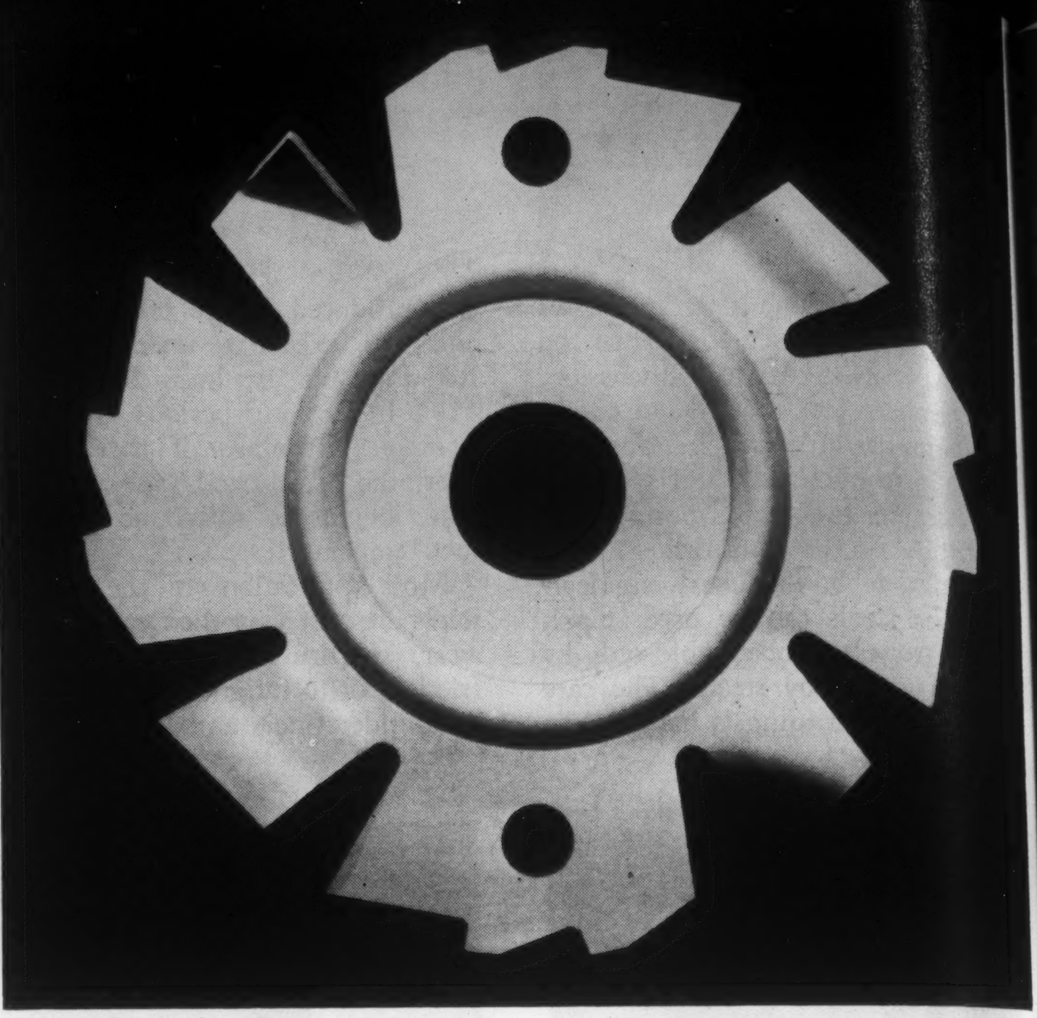
Part Clutch shaft
Material Nitralloy 135, modified, steel
Case Depth 0.020 in. (on splines)
Case Hardness Rockwell 15N 92 to 93
Prior Treatment Quenched in oil from 1700 F, tempered 1050 F for 3 hr to produce core hardness of Rockwell C34 to C36
Method Gas Nitriding
  Ammonia dissociation 40%
  Temp 975 F
  Time 65 hr

Carbonitriding and Cyaniding

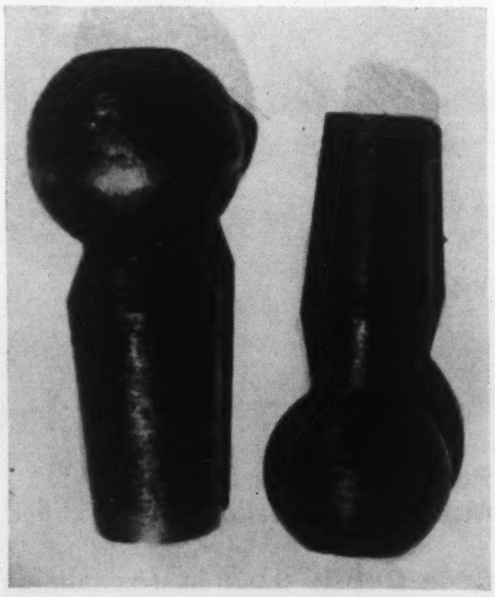
Steels are carbonitrided at lower temperatures than are usually used for carburizing, thus somewhat reducing the tendency toward distortion of the part. Although such steels must usually be quenched to develop full hardness, lower quenching rates can be used than are generally required for carburized parts and softer cores are obtained. For many applications carbon steels can be used instead of alloy steels with corresponding reductions in the cost of the product.

Cyaniding was the original liquid bath case-hardening method. Parts must be quenched to produce maximum hardness. Cyaniding and carbonitriding are used as alternate methods. The cases produced are similar in depth, composition and properties. The two processes are economical for the production of thin cases on small parts.

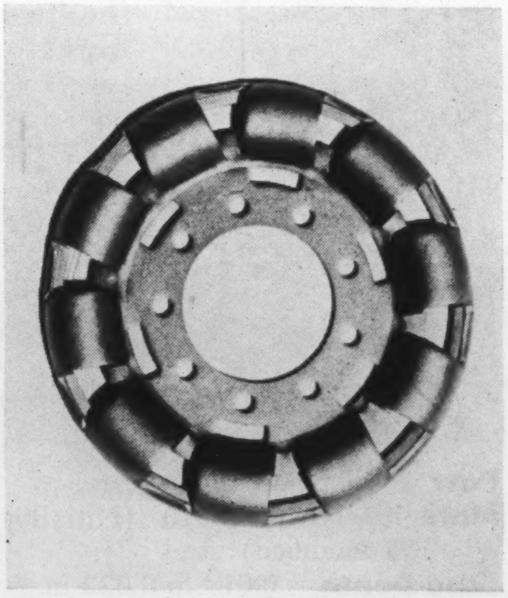
Typical applications are the case hardening of stampings, small machine parts, screws and intricate parts where distortion is a major problem. Carbonitriding has been used as an alternate to carburizing in quite a number of automotive parts. Cyaniding is used also for the case hardening of tools.



Part Agitator Disk (agricultural)
Material AISI 1010 steel
Case Depth 0.015 to 0.019 in.
Case Hardness Rockwell 15N 90 min
Method Carbonitriding
Temp 1575 F
Time 2 hr
Subsequent Heat Treatment Quenched in mineral oil, not tempered



Part Steering ball studs
Material SAE 8620 steel
Case Depth 0.010 to 0.015 in.
Method Carbonitriding
Atmosphere Cracked carrier gas enriched with natural gas and ammonia
Temp 1575 F
Time 1 to 1½ hr
Subsequent Heat Treatment Direct quenching into oil



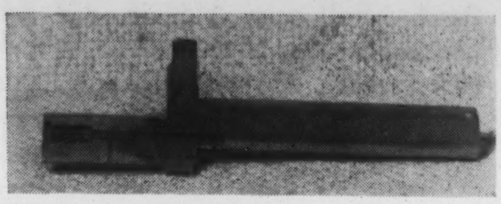
Part Clutch outer retainer plate
Material SAE 1010 steel
Case Depth 0.004 to 0.005 in.
Method Carbonitriding
Atmosphere Carrier gas enriched with natural gas and ammonia
Temp 1550 F
Time 10 min
Subsequent Heat Treatment Quenched into oil at 150 F

Part Clutch release lever
Material SAE 1010 steel
Case Depth 0.023 to 0.025 in.
Case Hardness Rockwell A80 to A81
Method Carbonitriding
Atmosphere Carrier gas enriched with natural gas and ammonia
Temp 1650 F
Time 2 hr
Subsequent Heat Treatment Quenched into oil at 150 F

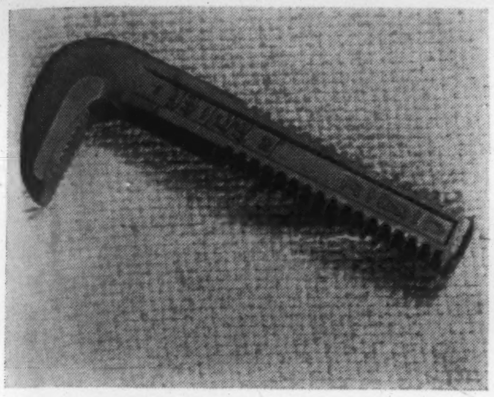
Flame Hardening

This process is applicable to steels which can be hardened by heat treatment in the conventional fashion. There is no change in the composition. Medium carbon steels are generally used and the maximum hardness obtainable depends on the carbon content. The steels can be heat treated to obtain desired core properties before hardening since the core is not affected by the process. One of the major advantages of flame hardening is the ability to harden parts too large for furnacing. Others are the simplicity and portability of the equipment required and its readiness for instant use. Flame hardening machines have been developed with high production rates on small parts. These machines have been placed in many production lines.

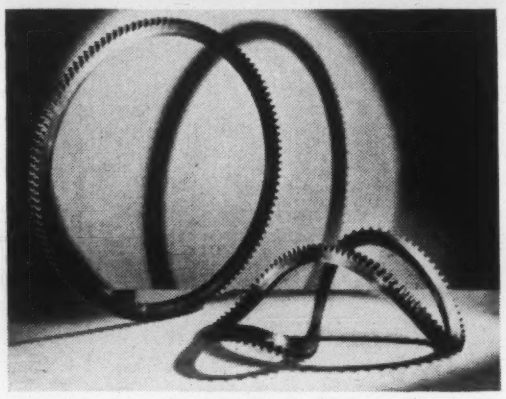
Among applications of flame hardening are the selective hardening of the wearing surfaces of large machine parts and the teeth of large gears, the production line hardening of the wearing surfaces of small gears and camshafts, the hardening of circular parts such as sheaves and the surface hardening of armor plate. Flame hardening is employed widely also for the surface hardening of various cast irons.



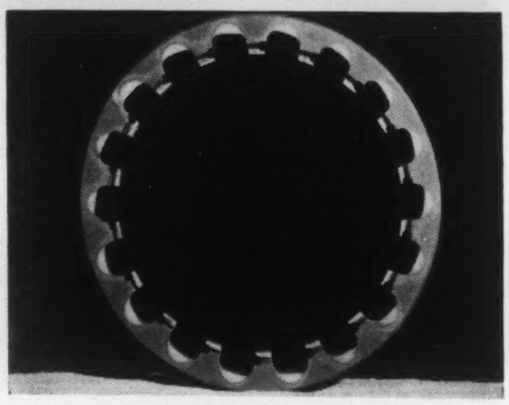
Part Crankshaft
Material Pearlitic malleable iron
Case Depth 1/8 in.
Case Hardness Rockwell C45 to C55
Prior Treatment Cycle annealed
Method Flame hardening
Gases Used Natural gas and oxygen
Remarks Bearing diameters were hardened, flange and core remained soft



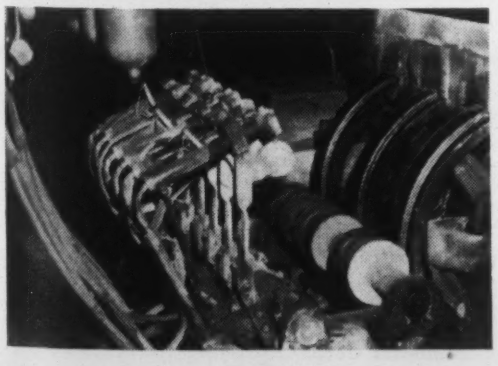
Part Wrench jaws
Material SAE 8750 steel
Case Depth 1/16 in. min from root of tooth
Case Hardness Rockwell C54 to C59
Prior Treatment Heat treated to Rockwell C39 to C49
Method Flame Hardening
Gases Used Propane and oxygen
Remarks Serrated section of jaws hardened, all areas excepting jaws proper remained soft



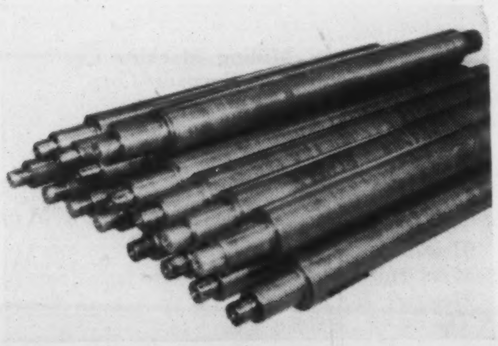
Part Automotive ring gear
Material SAE 1045 steel
Case Depth Below pitch line
Case Hardness Rockwell C52 to C58
Method Flame Hardening
Gases Used Propane and oxygen
Remarks Teeth to be hardened, body to remain soft. Twisted gear shows that core has not been disturbed during surface hardening



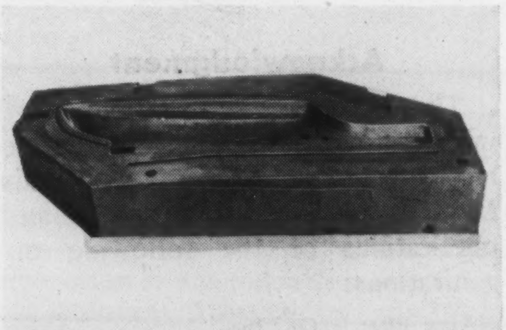
Part Cam, transmission
Material SAE 3145 steel
Case Depth 0.080 to 0.100 in. min
Case Hardness Rockwell C58 to C60
Prior Treatment Heat treated to Rockwell C30 to C36
Method Flame Hardening
Gases Propane and oxygen
Remarks 18 internal bearing surfaces to be hardened, material between lobes to remain soft



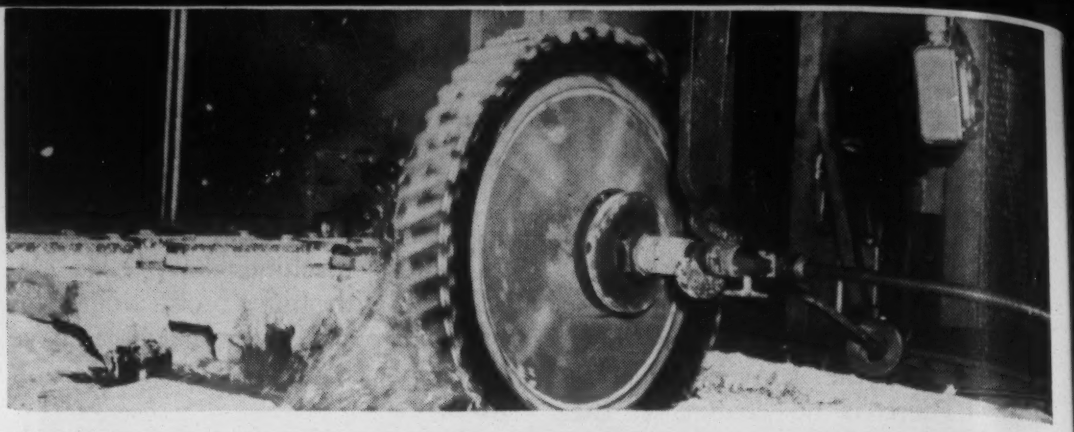
Part Tractor idlers
Material 0.42 carbon, 0.75% manganese steel
Case Depth 1/8 in.
Case Hardness Rockwell C45
Method Flame hardening
Gases Acetylene and oxygen
Travel 6½ in. per min



Part Steel rolls 6 in. dia
Material Steel
Case Hardness Rockwell C60
Method Flame hardening
Remarks Bearing surfaces and outside diameter hardened by progressive-spinning method



Part Stamping die
Material Gray cast iron or alloy cast iron
Case Hardness Rockwell C55 to C60
Method Flame hardening
Remarks Size of die is immaterial since only areas subject to wear are hardened



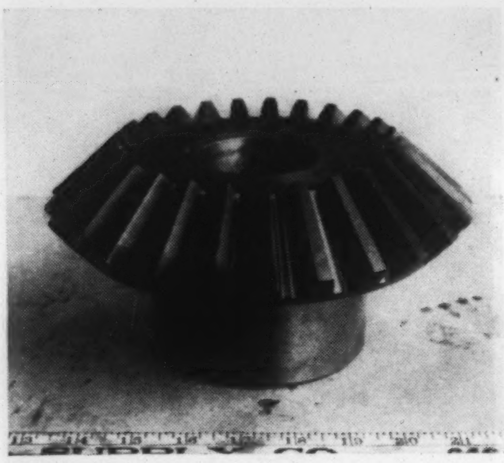
Part Bull gear, 24¾-in. dia
Material SAE 1045 steel
Hardening Method Liquid flame hardening
Temp 1600 F
Time 8 min

Induction Hardening

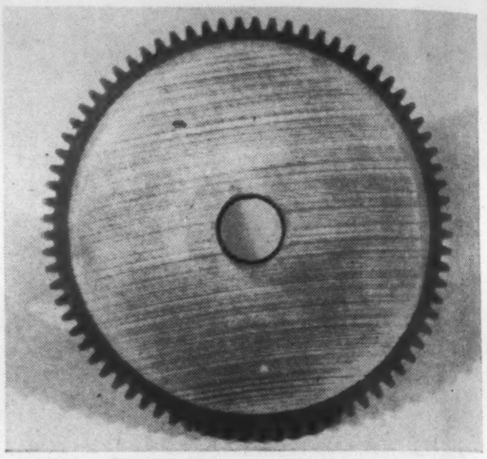
This is the fastest heating method of the group. Like flame hardening it is applicable to steels hardenable by conventional methods and is usually used for hardening medium carbon steels. Because of the rapid rate of heating to the quenching temperature, distortion and scaling are minimized. The apparatus can be installed in the assembly line and is particularly adaptable to mass production operations.

A major application is the hardening of crank-shafts, camshafts and axle shafts of all sizes, including some weighing 3600 lb. Other applications include localized surface hardening of cams, hardening of small parts such as wrist pins and piston pins, cutlery and shear blades, teeth of lead screws for precision machine tools.

Part Adjustable wrench
Material 0.50% carbon steel with boron addition
Case Depth ⅛ in.
Case Hardness Rockwell C58 to C60
Method Induction hardening
Temp 1550 F
Time 1.5 sec (6 in. size), 2.6 sec (12 in. size)
Remarks Hardened on working surface of jaw



Part Gear
Material Steel
Case Hardness Rockwell C60 as hardened
Method Induction hardening
Remarks Tempered to Rockwell C42 after hardening



Part Spur gear
Material SAE 4140 steel
Case Hardness Rockwell C50 to C55
Prior Treatment Heat treated to Rockwell C26 to C30
Method Induction hardening, 360 kilocycles
Time 10 sec
Subsequent Heat Treatment Tempered 1 hr at 400 F
Notes Teeth hardened symmetrically by rotating gear in field. Etched to show hardened zone.

Acknowledgment

The author wishes to acknowledge with sincere appreciation the help he received in the preparation of this Manual from the personnel and publications of the following organizations:

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Dempsey Industrial Furnace Corp.
Denfis Chemical Co.
Detroit Flame Hardening Co.
Doughty Laboratories Inc.
The Dow Furnace Co.
E. I. du Pont de Nemours & Co., Inc.
Ferguson Equipment Corp.
Heatbath Corp.
Hevi Duty Electric Co.
Holcroft & Co.
The A. F. Holden Co.
E. F. Houghton & Co.
International Nickel Co., Inc.
Ipsen Industries, Inc.
Ipsenlab of Rockford, Inc.
Leeds & Northrup Co.
Lepel High Frequency Laboratories, Inc.
Lindberg Engineering Co.
Lindberg Steel Treating Co.
Linde Air Products Co.
Loftus Engineering Corp.
The Matheson Alkali Works, Inc.
Mitchell-Bradford Chemical Co.
The Nitralloy Corp.
The Ohio Crankshaft Co.
Park Chemical Co.
W. S. Rockwell Co.
Sunbeam Corp.
Surface Combustion Corp.
Utica Drop Forge & Tool Corp.
Westinghouse Electric Corp.

*PICTURE CREDITS: **Ajax Electric Co., Inc.; American Cyanamid Co.; Brubaker Tool Corp.; Budd Mfg. Co.; Chain Belt Co.; Chrysler Corp.; Cincinnati Milling Machine Co.; De Laval Steam Turbine Co.; Detroit Flame Hardening Co.; Ford Instrument Co.; Harrison Steel Casting Co.; Hevi-Duty Electric Co.; Ipsenlab of Rockford, Inc.; Leeds & Northrup Co.; Lindberg Steel Treating Co.; Linde Air Products Co.; W. H. Nichols.; Nitralloy Corp.; Ohio Crankshaft Co.; Ross Gear & Tool Co.; Surface Combustion Corp.; Utica Drop Forge and Tool Co.; Westinghouse Electric Corp.; Worthington Corp.; and Wright Aeronautical Div.***

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Materials Engineering File Facts

MATERIALS & METHODS
October • 1953
Number 262

Materials Data Sheet

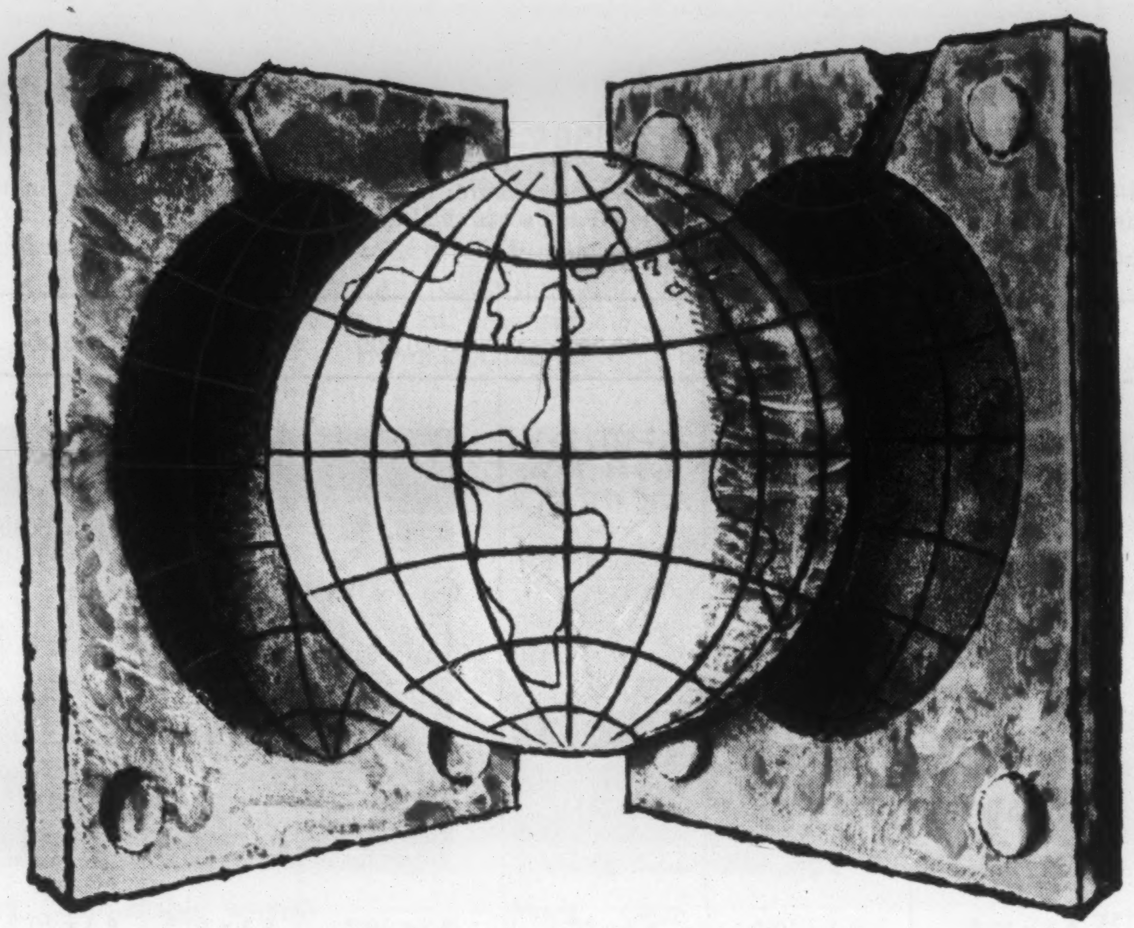
Properties of Steel Castings

Steel castings are generally specified by mechanical properties, leaving to the producer control of the chemistry within certain limits. Minimum mechanical properties and maximum chemical composition were included in a File Fact in the July 1952 issue.

Structural Grades—Carbon Steels

TENSILE STRENGTH, PSI	60,000	65,000	70,000	80,000	85,000	100,000
CURRENT SPECIFICATIONS						
ASTM	A-27-52T, U60-30, 60-30; A216-27T, WCA	A27-52T 65-30, 65-35; A352-52T, LCB	A27-52T, 70-36; A95-44, 70-36; A216-47T, WCB	—	—	—
SAE	—	Auto. 0030	—	Auto. 080	Auto. 0050	Auto. 0050
AAR	M201-47, Au, AA	—	M201-46, B	—	—	—
Federal	QQ-S-681b, Class 1	QQ-S-681b, Class 2	—	QQ-S-681b, Class 3	—	—
Military	Mil-S-15083B	—	Mil-S-15083A70	Mil-S-15083A80	—	—
ABS	Class 1	Class 2	—	—	—	—
Lloyds	—	Class A	—	—	—	—
PHYSICAL PROPERTIES						
Density, Lb/Cu In.	0.283	0.283	0.283	0.283	0.283	0.283
Thermal Cond, Btu/Hr/Sq Ft/Ft/F @ 212 F	27	27	27	27	27	27
Coeff of Exp per F: 70-1200	8.3×10^{-6}	8.3×10^{-6}	8.3×10^{-6}	8.3×10^{-6}	8.3×10^{-6}	8.3×10^{-6}
Spec Ht, Btu/Lb/F:	0.10–0.11	0.10–0.11	0.10–0.11	0.10–0.11	0.10–0.11	0.10–0.11
Elec Res, Microhm-Cm @ 68 F:	13–16	13–16	13–16	13–16	13–16	13–16
Magnetic Properties	Magnetic	Magnetic	Magnetic	Magnetic	Magnetic	Magnetic
MECHANICAL PROPERTIES[1]						
Mod of Elast in Tension, Psi	30.1×10^6	30.1×10^6	30×10^6	29.9×10^6	29.9×10^6	29.7×10^6
Tensile Str, 1000 Psi:	60 (a)	65 (b)	70 (b)	80 (c)	85 (c)	100 (d)
Yield Point, 1000 Psi:	30	35	38	45	50	70
Elong in 2 In., %:	32	30	28	26	24	20
Reduction of Area, %:	55	53	50	43	40	46
Hardness, Bhn:	120	130	140	160	175	200
Impact Str, Izod, Ft-Lb:						
(70 F)	30	30	30	25	20	30
(—50 F)	8	12	10	12	10	15
Fatigue Str, (End Limit), 1000 Psi:	25	28	31	35	38	47
THERMAL TREATMENT						
Annealing Temp, F	About 200 F above critical range					
Quenching Temp, F	About 100 F above critical range					
Tempering Temp, F	To desired mechanical properties					
FABRICATING PROPERTIES						
Machinability Index (B1112 Steel=100)	55	60	65	70	70	65
Weldability	Can be welded by procedures used for welding wrought steels of similar composition.					
CORROSION RESISTANCE	The carbon steels rust when brought into contact with moisture and air at rates which are not affected by the carbon content. If salts are present, the corrosion rate is increased. These steels are attacked readily by acids but are resistant to alkalies at ordinary temperatures.					
SPECIAL CHARACTERISTICS	Low electrical resistivity. Desirable magnetic properties. Carburizing and case hardening grades. Weldability.	Excellent weldability. Medium strength with good machinability and high ductility.		High strength carbon steels with good machinability, toughness and excellent fatigue resistance.		Wear resistance. Hardness.

(*Continued on page 155*)



Shell Molding Opens a New World!

Yesterday saw molten metal cast in extremely cumbersome, hard-to-handle sand molds.

Today a new world is emerging from a thin shell of sand bound together with phenolic resins. This is the world of shell molded castings – economical, amazingly precise and free from flaws.

As a leader in creative chemistry, Reichhold is reaching out to the challenge of this great new world. It is expanding its facilities to meet the ever increasing demand for phenolic resins created by the shell molding process.

In the foundry industry, as in many other fields of enterprise, Reichhold continues to pioneer . . . to perfect . . . and to produce. So it is that RCI has plants around the world – *wherever* basic raw materials are found . . . *wherever* industry needs its products!

REICHHOLD CHEMICALS, INC.
630 Fifth Avenue, New York 20, N. Y.

Creative Chemistry . . . Your Partner in Progress

REICHHOLD

Uses of RCI Products

CANVAS, PAPER AND GLASS CLOT
LAMINATES: PLYOPHEN cresol, phenol
and resorcinol-formaldehyde resins an
varnishes; RCI polyester resins.

CARBON PAPER: RCI inorganic chem
ical pigment colors.

CASTINGS: FOUNDREZ powdered phe
nolic resins (for the shell molding proc
ess); FOUNDREZ liquid phenolic resins an
FOUNDREZ core oils (for core binders

FURNITURE, PLYWOOD, FLOORING
HARDBOARD AND CHIPBOARD
HYDROPHEN phenolic glues; PLYACIE
protein glues; PLYAMINE urea-formalde
hyde glues; PLYOPHEN phenolic and re
sorcinol-formaldehyde glues.

LEATHER: BECKOSOL alkyd resins (fo
leather finishes); PLYOPHEN resorcino
formaldehyde resins, SUPER-BECKACIT
pure phenolic resins, SYNTHE-COPA
ester gums (for leather adhesives).

LINOLEUM: BECKOSOL alkyd resins an
PENTACITE pentaerythritol resins (fo
linoleum coatings); RCI inorganic chem
ical pigment colors.

PAINTS, VARNISHES AND LACQUERS
BECKACITE (1) fumaric, (2) maleic and (3
modified phenolic resins; BECKAMIN
urea-formaldehyde resins; BECKOLI
synthetic oils; BECKOPOL modified phe
nolic resins; BECKOSOL (1) phenolated, (2
phthalic-free, (3) rosin modified, (4) pur
drying and (5) pure non-drying alky
resins; KOPOL processed Congo copal
PENTACITE pentaerythritol resins; STY
RESOL styrenated alkyd resins; SUPER
BECKACITE pure phenolic resins; SYNTHE
COPAL ester gums; WALLKYD pure dry
ing alkyd resins (for alkyd flat wall vehi
cles); WALLPOL vinyl-type copolymer late
emulsions (for latex flat wall coatings
RCI inorganic chemical pigment colors

PAPER: BECKAMINE urea-formaldehyd
resins (for adding wet strength, improv
ing the wet rub of starch-clay coatings
and waterproofing starch adhesives
RCI inorganic chemical pigment colo
(for paper coloring); STYRESOL styrenate
alkyd resins (for paper coating).

PRINTING INKS: BECKACITE fumaric, ma
leic and modified phenolic resins; BECKO-
LIN synthetic oils; BECKOPOL modified
phenolic resins; RCI inorganic chemica
pigment colors.

TYPEWRITER RIBBONS: RCI inorgani
chemical pigment colors.

WAXES AND POLISHES: BECKACIT
modified phenolic and maleic resin
SUPER-BECKACITE pure phenolic resin
SYNTHE-COPAL ester gums.

RCI

For more information, turn to Reader Service Card, Circle No. 378

Materials Engineering File Facts

MATERIALS & METHODS
October • 1953
Number 262

Engineering Grades—Low Alloy Steels[2]

TENSILE STRENGTH, PSI		70,000	80,000	90,000	100,000	110,000
CURRENT SPECIFICATIONS	ASTM	A217-49T, WC4, WC5, WC6, WC9, A32-52T, LC1, LC2, LC3	A148-50T, 80-40, 80-50	A148-50T, 90-60, A217-49T, C5	—	A148-50T, 105-85
	SAE	—	Auto. 080	Auto. 090	—	Auto. 0105
	AAR	—	—	M201-47, C	—	—
	Federal	—	QQ-S-681b, 4A1	QQ-S-681b, 4A2, 4B1, 4B2, 4C1	QQ-S-681b, 4B3	QQ-S-681b, 4C2
	Military	Mil-S-15464, Class 1 and 2	Mil-S-15083A80	Mil-S-15083A90	Mil-S-15083A100	—
PHYSICAL PROPERTIES						
Density, Lb/Cu In.		0.283	0.283	0.283	0.283	0.283
Thermal Cond, Btu/Hr/Sq Ft/Ft/F,@212 F		27	27	27	27	27
Coeff of Exp per F: 70-1200		8.0–8.3 x 10^{-6}	8.0–8.3 x 10^{-6}	8.0–8.3 x 10^{-6}	8.0–8.3 x 10^{-6}	8.0–8.3 x 10^{-6}
Spec Ht, Btu/Lb/F:		0.10–0.11	0.10–0.11	0.10–0.11	0.10–0.11	0.10–0.11
Elect Res, Microhm-Cm @ 68 F:		15–20	15–20	15–20	15–20	15–20
Magnetic Properties		Magnetic	Magnetic	Magnetic	Magnetic	Magnetic
MECHANICAL PROPERTIES[1]						
Mod of Elast in Tension, Psi:		29–30 x 10^6	29–30 x 10^6	29–30 x 10^6	29–30 x 10^6	29–30 x 10^6
Tensile Str, 1000 Psi:		70 (c)	80 (c)	90 (c)	100 (c)	110 (d)
Yield Point, 1000 Psi:		45	50	60	68	85
Elong in 2 In., %:		26	24	22	20	20
Reduction of Area, %:		56	50	46	42	45
Hardness, Bhn:		150	170	190	209	235
Impact Str, Charpy, Ft-Lb: (70 F)		35	30	26	22	23
(—50 F)		25	20	15	12	18
Fatigue Strength (End Limit), 1000 Psi:		33	38	41	45	49
THERMAL TREATMENT						
Annealing Temp, F		About 200 F above critical range				
Quenching Temp, F		About 100 F above critical range				
Tempering Temp, F		To desired mechanical properties				
FABRICATING PROPERTIES						
Machinability Index (B1112 Steel=100)		65	70	70	65	60
Weldability		Can be welded by procedures used for wrought steels of similar composition.				
CORROSION RESISTANCE		In general, the corrosion resistance of these steels is similar to that of the carbon steels.				
SPECIAL CHARACTERISTICS		Excellent weldability. Medium strength with high toughness and good machinability. High temperature service.		Certain steels of these classes have excellent high temp properties and deep hardening properties. Toughness.		High resistance to impact. Excellent low temp properties for certain steels. Deep hardening. Excellent combination of strength and toughness.

(*Continued on page 157*)

UNIVERSITY OF MICHIGAN LIBRARIES

More electric power for the biggest state

...with the Help of the Biggest "S" Monel Impeller Inco Ever Cast

This 3023-pound "S" Monel pump impeller was installed in an 84-inch Morris Vertical Axial Flo Pump at the MORRIS MACHINE WORKS, Baldwinsville, N. Y. The largest "S" Monel impeller ever cast, its size is a sharp contrast to the impeller in the man's hand–one of the stock models produced by the hundreds in Inco's foundry. The pump is capable of handling 120,000 gallons per minute at a total Discharge Head of 10.5 feet, designed to operate if normal water flow is interrupted for any reason.

Everything's big in Texas.

But a Texas chemical company found that electric power output wasn't big enough to meet requirements for increased production.

The only solution was to build another generating plant.

For cooling, the plant could use brackish sea water with a mean temperature of 85° F. In short order such water could damage the emergency pump used to maintain proper circulation of the condenser discharge water from the turbine generators. Costly shut downs were sure to result unless the pump impeller was made of a hard and corrosion resisting material.

So when the chemical company ordered an 84-inch custom-built Morris Vertical Axial Flo Pump, it specified "S"® Monel for the impeller. And for additional pump protection it specified centrifugally cast Monel® pump sleeves.

They called on Inco to cast the "S" Monel pump impeller. When finished, it weighed 3023 pounds – the largest "S" Monel impeller they had ever cast!

Inco-Cast sand or centrifugal castings may be a practical solution to some problem in your plant. Take a look at what you get with Inco castings.

1. Castings that frequently outlast other materials under destructive service conditions. That's because they are made of Inco Nickel Alloys, which have been especially developed to withstand corrosion, abrasion, erosion and galling.
2. Castings in any practical shape or size you need. Inco has specialized in castings for over 47 years and is equipped to make your castings whether they weigh a few ounces or tons.
3. High quality castings because they are made to meet or exceed Government specifications for these high Nickel Alloys.
4. The benefit of Inco's help in solving your metal problems based on wide experience in field and laboratory testing of Nickel Alloys.
5. Inco Nickel Alloy castings made at Inco's own foundry; your assurance of sound, dependable castings.
6. Even castings you previously thought impractical to produce in Monel, Nickel or Inconel® can often be cast by Inco's specialists.

Do you have the problem of selecting a cast alloy to withstand corrosion, abrasion, erosion or other destructive conditions? Let Inco casting specialists study your problem. They may be able to suggest a practical solution. They will also be glad to give you cost and delivery estimates on all rated orders.

In the meantime, write for your copy of "When it's a question of castings . . ."

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N.Y.

Inco Castings

INCO TRADE MARK

SAND, CENTRIFUGAL, PRECISION

For more information, turn to Reader Service Card, Circle No. 341

Materials Engineering File Facts

MATERIALS & METHODS
October • 1953
Number 262

NUMBER 262 (continued) PROPERTIES OF STEEL CASTINGS

Engineering Grades—Alloy Steels[2] (continued)

TENSILE STRENGTH, PSI	120,000	150,000	175,000	200,000
CURRENT SPECIFICATIONS				
ASTM	A148-50T, 120-95	A148-50T, 150-125	A148-50T, 175-145	None specified
SAE	Auto. 0120	Auto. 0150	Auto. 0175	—
Federal	QQ-S-681b, 4C3	QQ-S-681b, 4C4	—	—
PHYSICAL PROPERTIES				
Density, Lb/Cu In.	0.283	0.283	0.283	0.283
Thermal Cond, Btu/Hr/Sq Ft/Ft/F, @ 212 F	27	27	27	27
Coeff of Exp per F: 70-1200	$8.0\text{–}8.3 \times 10^{-6}$	$8.0\text{–}8.3 \times 10^{-6}$	$8.0\text{–}8.3 \times 10^{-6}$	$8.0\text{–}8.3 \times 10^{-6}$
Spec Ht, Btu/Lb/F:	0.10–0.11	0.10–0.11	0.10–0.11	0.10–0.11
Elec Res, Microhm-Cm @ 68 F:	15–20	15–20	15–20	15–20
Magnetic Properties	Magnetic	Magnetic	Magnetic	Magnetic
MECHANICAL PROPERTIES				
Mod of Elast in Tension, Psi	$29\text{–}30 \times 10^{6}$	$29\text{–}30 \times 10^{6}$	$29\text{–}30 \times 10^{6}$	$29\text{–}30 \times 10^{6}$
Tensile Str, 1000 Psi:	120 (d)	150 (d)	175 (d)	200 (d)
Yield Point, 1000 Psi:	95	125	148	170
Elong in 2 In., %:	16	12	8	5
Reduction of Area, %:	38	25	20	11
Hardness, Bhn:	245	300	340	400
Impact Str, Charpy, Ft-Lb: (70 F)	20	14	10	—
(—50 F)	16	10	6	—
Fatigue Str, (End Limit), 1000 Psi:	55	65	77	85
THERMAL TREATMENT				
Annealing Temp, F	About 200 F above critical range			
Quenching Temp, F	About 100 F above critical range			
Tempering Temp, F	To desired mechanical proportion			
FABRICATING PROPERTIES				
Machinability Index (B1112 Steel=100)	50	30	—	—
Weldability	Can be welded by procedures used for wrought steels of similar composition.			
CORROSION RESISTANCE	In general, the corrosion resistance of these steels is similar to that of the carbon steels.			
SPECIAL CHARACTERISTICS	High resistance to impact. Excellent low temp properties for certain steels. Deep hardening. Excellent combination of strength and toughness.	Deep hardening. High strength. Wear resistance. Fatigue resistance.	High strength. Wear resistance. High hardness. High fatigue resistance.	

FOOTNOTES:

[1] *Normally expected values in the production of steel castings for the tensile strength values listed.*

[2] *Below 8% total alloy content.*

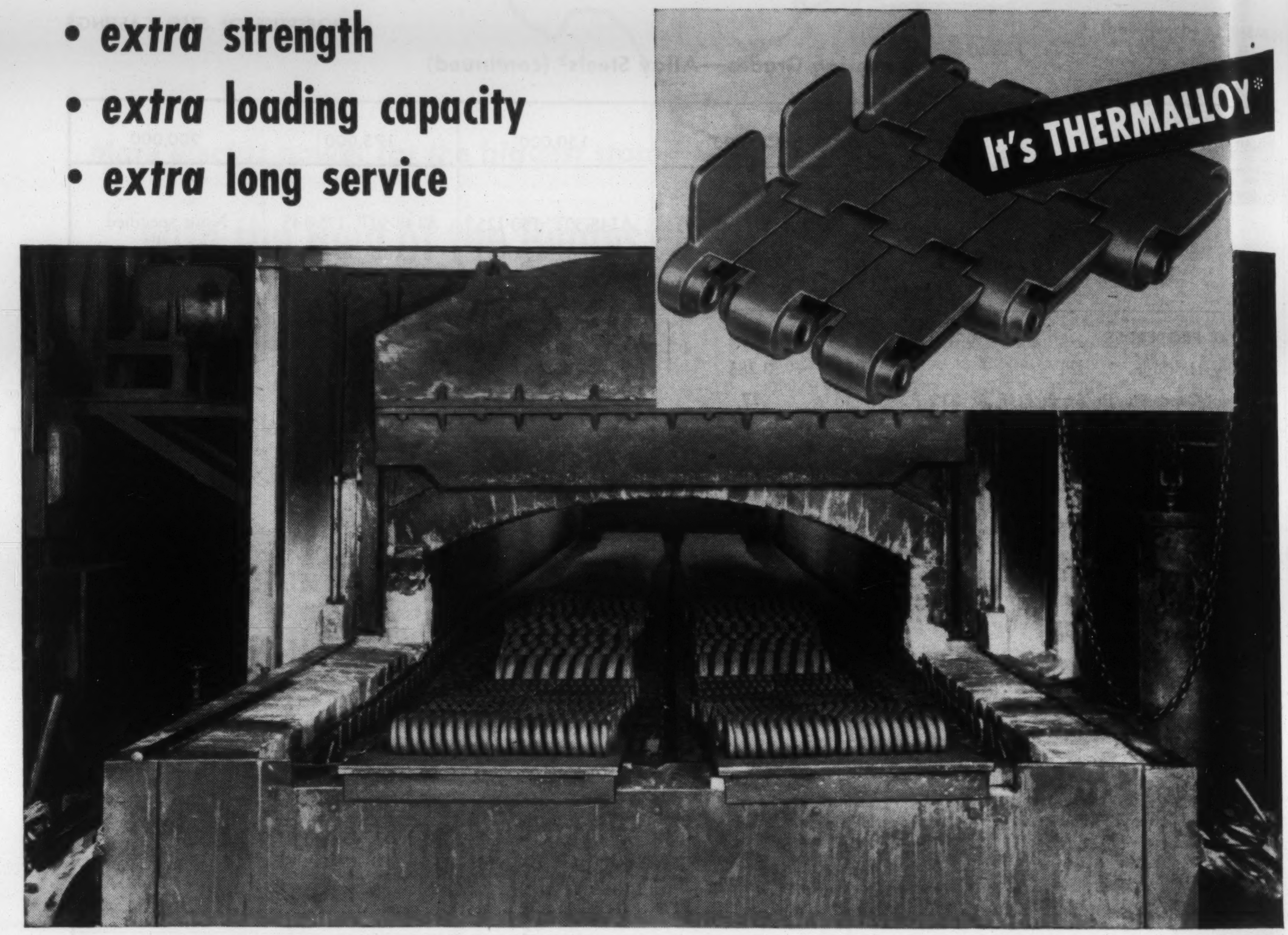
(a) Annealed (b) Normalized (c) Normalized and Tempered (d) Quenched and Tempered

Prepared with the assistance of the Steel Founders' Society of America

NEW CONVEYOR DESIGN

offers *extra* heat-treat advantages . . .

- *extra* strength
- *extra* loading capacity
- *extra* long service



This new conveyor belt† was designed to carry loads not possible with conventional style belts. It does not replace conventional cast belts, but serves to widen the field to applications involving extreme temperature and loading conditions formerly unattainable with ordinary belts.

The new Thermalloy staggered-link, conveyor design shown above offers you these features:

1. Elimination of crank-shafting.
2. A free-floating link which can adjust itself to meet localized stresses.
3. The substitution of strong, wear-resistant, cast-in pins for the weaker wrought pins.

For complete information on this new Thermalloy conveyor belt, standard belts or other furnace parts, contact your nearest Electro-Alloys representative. Or write Electro-Alloys Division, 4001 Taylor Street, Elyria, Ohio.

*Reg. U.S. Pat Off.

†Pat. Applied For

AMERICAN
Brake Shoe
COMPANY

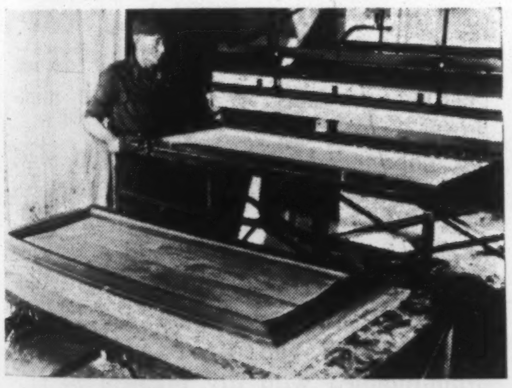
ELECTRO-ALLOYS DIVISION
ELYRIA, OHIO

For more information, turn to Reader Service Card, Circle No. 426

New Materials and Equipment

Plastic Sheet Produces Glossy Finish on Vacuum Formed Parts

The vacuum forming process has been of interest to plastics manufacturers largely due to the economies inherent in the use of low cost dies and molds. However, when a glossy finish is required on the part, additional costs have been incurred by a secondary, finishing process, since plastic sheets heretofore formed in this manner produced only a matte surface on the product. The recent development of a new, thin extruded plastic sheet now eliminates this disadvantage and permits plastics manufacturers to utilize this inexpensive process, producing at the same time a glossy surface on the formed part, with no finishing operation necessary.

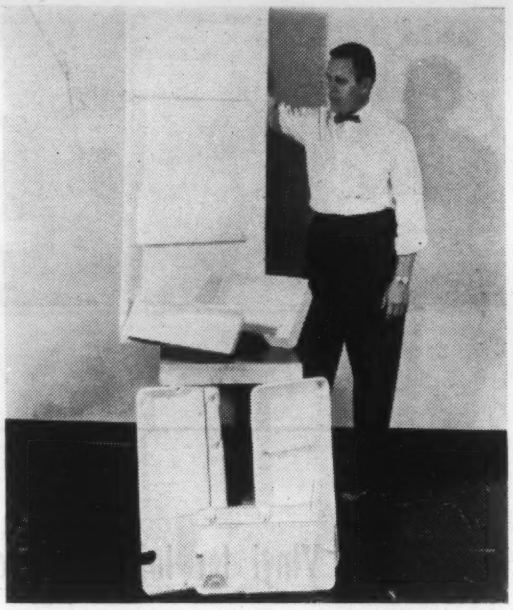


Inexpensive wooden forms are used in vacuum forming refrigerator door liner with Campco S-300.

Campco S-300, produced by the *Campco Div., Chicago Molded Products Corp.,* 2717 N. Normandy Ave., Chicago 35, is a copolymer of polystyrene and butadiene, and as such, is not unique; however, the Campco extrusion process is said to produce a thin sheet with a highly glossy finish that is maintained after vacuum forming. Since it is a continuous process, sheets of any length can be made with widths ranging from 26 to 58 in., and thicknesses ranging from 0.005 to 0.125 in.

With this additional advantage, Campco S-300 is said to sacrifice none of the other characteristics of a polystyrene-rubber plastic. It has a high impact strength without sacrifice of formability; it machines easily and is said to be dimensionally stable since its water absorption is low.

The manufacturer states that the sheet is particularly applicable for such uses as refrigerator door liners, drip pans, crisper units, meat keepers, and similar parts, and, in addition, for clothes hampers, foodhandling trays, wall tile, splash panels, table tops, and automobile interiors. The company predicts that Campco S-300 may also find wide usage in advertising displays and the printing field, since the range of colors that can be produced is unlimited, and easy formability is said to permit production of display units in which the colored design is first printed on the flat sheet before the forming operation. It is also possible, according to the company's engineers, to use the sheet as an inexpensive material for newspaper mats and printing plates.



Refrigerator components have white, high gloss finish after vacuum forming.

Precision Rolled Pure Titanium

Commercially pure titanium, precision-rolled to thin gage with close tolerances, has been announced as readily available at the *Industrial Div., American Silver Co., Inc.,* 36-07 Prince St., Flushing 54, N. Y. Rolled in strips up to 8 in. wide and down to 0.0005 in. thick and holding tolerances of 0.0001 in., the strip is said to be available in both development laboratory quantities and for high production runs.

Typical uses for titanium strip include: cowlings, ducts, fire walls, structural parts, power plant components, fittings and fastenings in the aircraft industry, condensers, heat exchangers, mufflers, metering equipment, valves, marine pumps, chemical processing equipment, instrumentation, refineries, and food processing and handling.

As is well known, titanium is an extremely strong, yet light-weight metal which can be compared favorably in strength to many steels, but weighs only 56% as much. It possesses excellent corrosion resistance and the ability to withstand high temperatures.

New Materials and Equipment continued

Treated panel at left is unharmed after 4½ sec exposure to oxyacetylene flame at about 5,000 F. Untreated panel at right burned through in less than 1 sec with the same flame.

Sprayed Coating Provides Thermal Insulation

A water base inorganic material that can be sprayed like paint on metal, making the treated surface capable of withstanding temperatures as high as 5,000 F, has been developed by the *B. F. Goodrich Co.*, Akron. Called Pyrolock, a 1/16 in. coating of the insulation is said to protect metal for as long as 10 sec against flame temperatures hotter than the melting point of metals.

According to the manufacturers, the material is non-toxic, non-flammable, non-explosive and will adhere directly to clean metal surfaces without sandblasting or use of priming surface preparations. Dried, it will bond itself to metal with a strength that withstands sharp impact short of actual deformation of the metal. Resistant to most solvents and chemicals, Pyrolock is said to withstand indefinitely temperature cycles of —60 to +165 F.

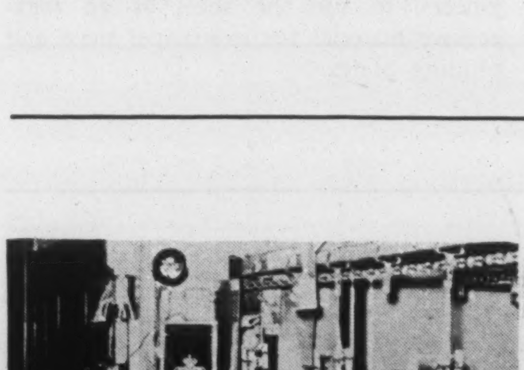
Looking toward the potential use of this material in industry, the manufacturers say that the material can be modified for use wherever resistance to flame and high temperatures is needed.

Heat-Stable Vinyl for Injection Molding

Production economy and high heat stability are two advantages claimed for a new line of vinyl compounds developed for injection molding by the *Monsanto Chemical Co.'s Plastics Div.*, Springfield, Mass. The compounds are free-flowing powders, which can be dry blended at the molder's level thus eliminating the need for expensive mixing and milling equipment. The manufacturer says that although they are offering eight ready-made blends, molders who elect to do their own dry blending stand to save as much as 25% on the cost of molding material.

In addition to the economies inherent in the dry blending process, the high heat stability claimed for the compounds is said to add another advantage. Since this blending process takes place at relatively low temperatures, the compounds reach the injection press with a minimum of heat history which will reduce the tendency toward decomposition sharply. Mold and machine corrosion by decomposition products is said to be minimized.

Compounded with Opalon 300 vinyl resin, the new blends also contain plasticizer, filler, stabilizer and lubricant. Proportions are varied to produce a wide range of properties in the finished moldings. The compounds are supplied in natural, black and white and may be drum-tumbled with dry pigment to produce an unlimited range of colors.



Conveyorized system of spray cleaning with Oakite Composition No. 26, one-stage cleaner.

One-Stage Detergent for Cleaning Metals

A heavy-duty cleaner, designed to remove in one operation extra-heavy soils from iron and steel, has been developed by *Oakite Products, Inc.*, 132H Rector St., New York. The manufacturer says that Oakite Composition No. 26 possesses a marked ability to wet and penetrate heavy soils quickly, loosening them so that subsequent rinsing leaves work surfaces thoroughly clean.

Among the advantages claimed for Composition No. 26 are: quick penetration of soils which reduces cleaning time, thorough soil removal and good rinsing action which leaves no insoluble or oily films on surfaces to interfere with painting or plating, simplicity in use, and economy, since the one-stage cleaning operation reduces the cleaning time and the consumption of materials.

Applications cited for the use of this compound are in removal of pigmented drawing compounds, removal of solid-particle dirts and smuts, cleaning before vitreous enameling, and precleaning buffed metal before electroplating.

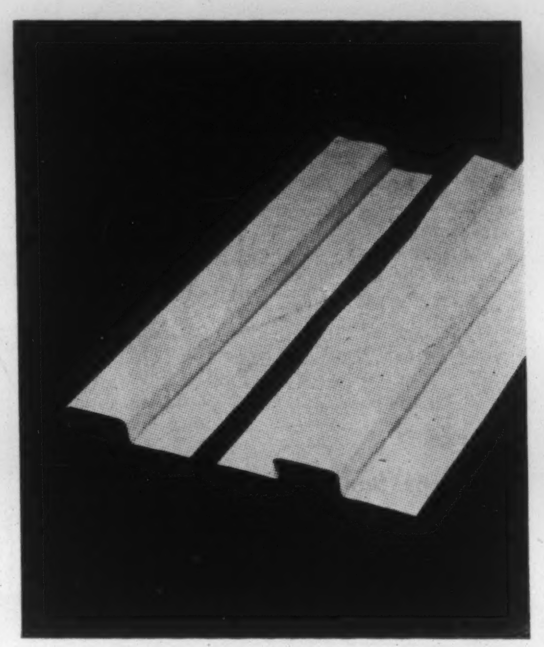
Gasket Material Combines Plastic and Rubber

A gasket material has recently been developed which combines the resilience and high-low temperature properties of silicone rubber with the chemical resistance of the fluorocarbons. The Fluorlastic gaskets, developed by the *Connecticut Hard Rubber Co.,* 407 East St., New Haven, consist of silicone rubber completely enveloped in Teflon or Kel-F.

The resilient core of silicone rubber sponge or solid silicone rubber, available in various durometers, is protected from chemical attack by the plastic envelope, which ranges in thickness from 0.0025 to 0.030 in., depending on the use requirements.

Strip-type gaskets in various shapes and sizes, in lengths up to 96 in. and widths of 4 in. are available with both Kel-F and Teflon envelopes. These gaskets are said to be used for hood, duct, and oven closures where corrosive conditions are encountered.

In ring form for flange gaskets, Kel-F envelopes are generally used since an impervious covering can be formed which will withstand complete immersion in corrosive substances.



Combination gasket material allows full use of properties of silicone rubber protected by fluorocarbon plastic.

New Plastic for Printed Circuits

A new laminate of epoxy resin and glass cloth, called Epoglas, is said to exhibit good mechanical and electrical properties making it particularly suitable for use in etched, plated and printed circuits. Developed by *Plastilight, Inc.,* 481 Canal St., Stamford, Conn., Epoglas is available either copper-clad on one or both sides, or unclad, for use in terminal boards or as a base for plated and printed circuits. Sheets are 24 by 36 in., and thicknesses range from 0.003 to 0.500 in.

The epoxy resin has a high bond strength to copper when laminated under heat and pressure. Since it requires no adhesive, the electrical and mechanical properties of both materials are retained unimpaired in the completed circuit. The manufacturer claims that Epoglas is well suited to dip-soldering and will not delaminate. The water absorption is said to be 0.016%, dielectric constant, surface resistivity and arc resistance high, and service temperature 340 F.

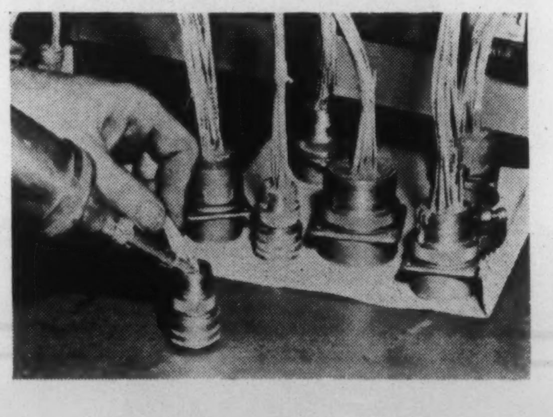
Dielectric Sealer Provides Flexibility and Moisture Resistance

The new EC-1120 Dielectric Sealer developed by *Minnesota Mining and Mfg. Co.,* 423 Piquette Ave., Detroit, is designed for use as a flexible potting compound on electrical wiring connections. It is said to retain physical properties throughout a temperature range of —65 to 200 F and combine moisture resistance and durability with its dielectric properties.

EC-1120, a synthetic rubber material, is applied in liquid form and cures to a tough, rubber consistency which is said to give both corrosion and vibration protection. These qualities suggest applications where flexibility is important, in the electrical and electronic manufacturing field as well as transportation and aircraft industries.

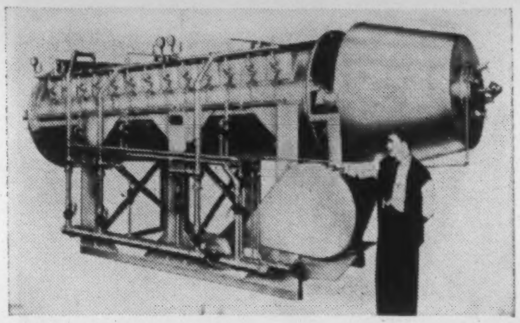
The sealer requires the use of an accelerator before use, and when mixed becomes a heavy liquid which flows readily, giving a uniform seal with good adhesion to both the wires and the surfaces of the connector plug, the company says. It can be applied by putty knife, spatula or gun.

The relatively high solids content of approximately 92% by weight insures against excessive shrinkage, and curing takes place at room temperature. When stored at temperatures below 75 F, unaccelerated EC-1120 is said to have a shelf life in excess of one year.



Potting compound gives both corrosion and vibration resistance to wire connections in electrical plugs.

Three Zone Rotary Heat Treat Furnace



Three zone furnace permits separate temperature control in heat treat operations.

A Rotary Retort Furnace, AGF Model 139DR, with three separate zones of temperature control has been developed by the *American Gas Furnace Co.,* Elizabeth, N. J. The external controls allow the operator to separately control the temperature in each of the zones which divide the furnace lengthwise in about equal parts. This feature permits "ON" and "OFF" operation during idling periods, while readily controlled burners allow temperature variation in each zone for special heating needs.

Separate pilot lights for the burners are said to make lighting easy and eliminate the danger of unlighted burners. Furnace inspection can be completed at a glance and the manufacturer states that the adaption of safety devices is a simple matter.

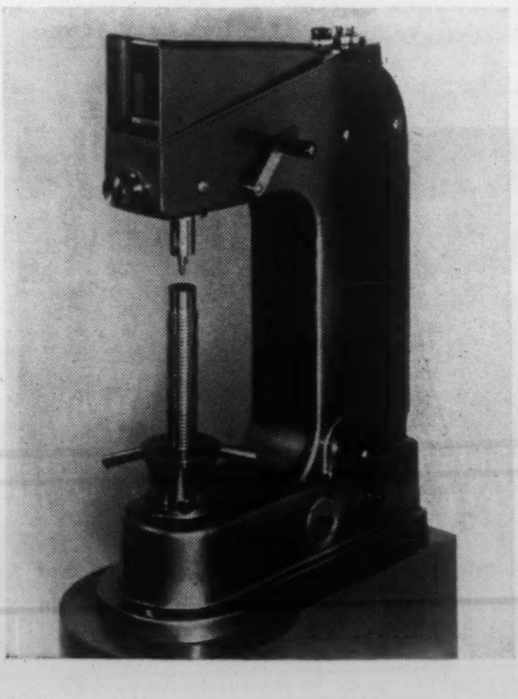
The heated work space is 15 in. in dia by 10 ft long, while the overall size is 16 ft long, 7½ ft high and 4½ ft deep. Production of nonferrous metal parts is said to be 1,000 lb per hr which can be regulated through the use of the self-metering hopper and the variable speed of rotation.

High Purity Claimed for New Copper Powder

In line with the increasing interest in powder metallurgy, the *Malone Metal Powders, Inc.,* Malone, N. Y. are now producing Dendritic Copper Powder with a density of less than half of the average granular type. The manufacturer says their Fernlock Copper Powder is radically different from other types in that its structure is feathery or fernlike, resulting in a much larger surface area. In contrast to flake powder it is entirely free of lubricants and in processing it undergoes a double purification resulting in extreme purity.

In the chemical field, the powder is recommended for catalytic processes and gas purification; while in metallurgy, it is used for carbon brushes, friction materials, as well as for the production of compacts that invariably require high green strength.

Hardness Tester Features Automatic Load Changer



Hand-operated metal hardness testers which provide automatic load changing and magnified optical readings are available at *Opplem Co., Inc.,* 352 Fourth Ave., New York 10, importers of the Galileo line of Italian optical and precision instruments. Both the Galileo Superficial Hardness Tester, which handles loads from 5kgm, and the Galileo Standard Hardness Tester, which handles Rockwell, Brinell, Vickers, and special tests, provide automatic load changing accomplished by turning a dial which switches the loads in the interior of the instrument.

Magnified optical readings as well as automatic load changing are features of this metal hardness tester.

The speed of load application is regulated by a built-in oil damper with external control. The magnified scales are projected on screens at the top of the instruments, which simplifies the reading of results.

The Superficial Tester is equipped to handle loads from 5 to 45 kg, while the Standard Tester provides loads of 31, 2-60-62, 5-100-150-187, and 5 kg with an extra 125 kg weight available. The large throat openings of the instruments allow the acceptance of samples up to 7½ in. thick. A variety of anvils and steel ball penetrators are supplied with the instruments, with the diamond cone penetrator provided as an accessory.

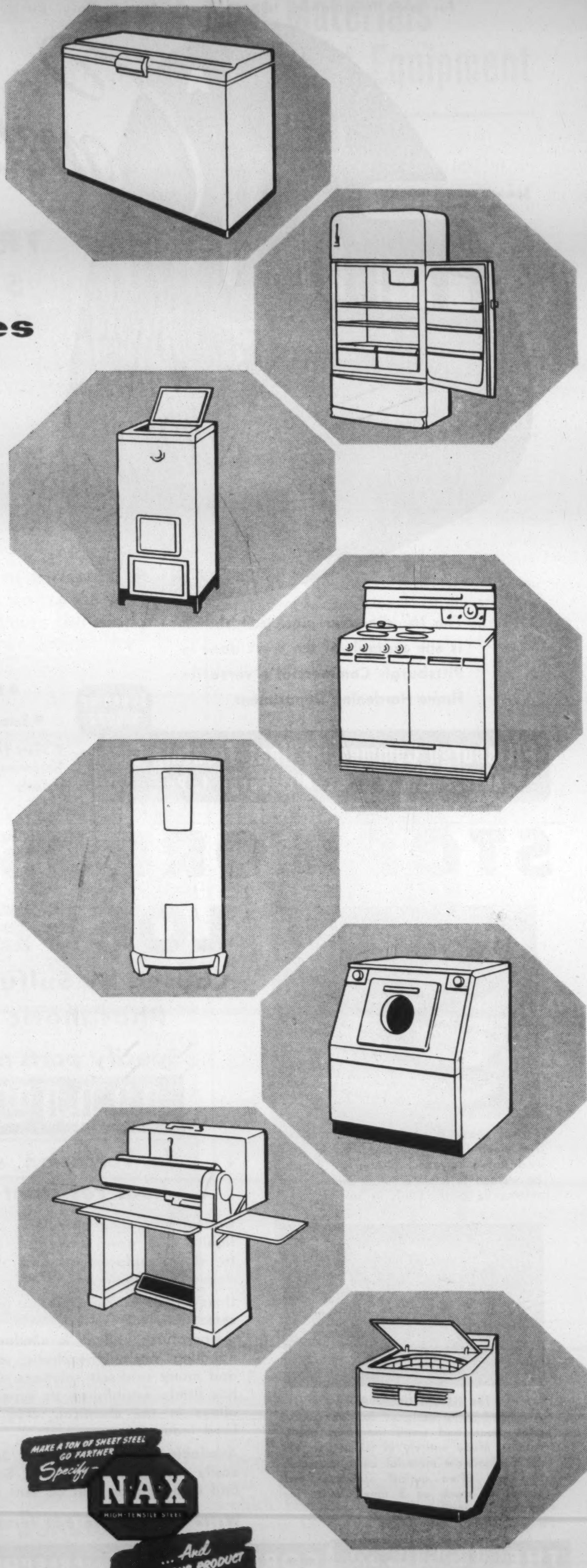
(More News on page 164)

for High Strength and Longer Life in Household Appliances

Specify

N·A·X

HIGH-TENSILE STEEL



N-A-X HIGH-TENSILE, having 50% greater strength than mild carbon steel, permits the use of thinner sections—resulting in lighter weight of products, yet with greater resistance to denting. It is a low-alloy steel—possessing much greater resistance to corrosion than mild carbon steel, with either painted or unpainted surfaces. Combined with this characteristic, it has high fatigue and toughness values and the abrasion resistance of a medium high carbon steel—resulting in longer life of products.

N-A-X HIGH-TENSILE, with its higher physical properties, can be readily formed into the most difficult stamped shapes, and its response to welding, by any method, is excellent. Due to its inherently fine grain and higher hardness, less surface preparation is required for either painted or plated parts.

Your product can be made lighter, resulting in shipping economies to consumer . . . to last longer . . . and in some cases be manufactured more economically, when made of N-A-X HIGH-TENSILE steel.

GREAT LAKES STEEL CORPORATION

N-A-X Alloy Division **Ecorse, Detroit 29, Michigan**

NATIONAL STEEL CORPORATION

MAKE A TON OF SHEET STEEL GO FARTHER

Specify—

N·A·X HIGH-TENSILE STEEL

. . . And "MAKE YOUR PRODUCT LAST LONGER"

KEEP YOUR SCRAP MOVING TO YOUR DEALER

For more information, turn to Reader Service Card, Circle No. 414

For more information, turn to Reader Service Card, Circle No. 416

Specially adapted Universal Flame Hardener

A Complete HEAT TREATING SERVICE

- Flame Hardening
- Induction Hardening
- Nitriding
- Cyaniding
- Chapmanizing
- Silver or Copper Brazing
- Cadmium or Copper Plating
- Stress Relieving
- Normalizing
- Gas Pack or Liquid Carburizing
- Annealing
- Roto-blasting
- Silver Finish Hardening of Dies or Tools

The 16" diameter pinch roll shown is one example of the work done in Pittsburgh Commercial's versatile Flame Hardening Department.

SChenley 1-6277

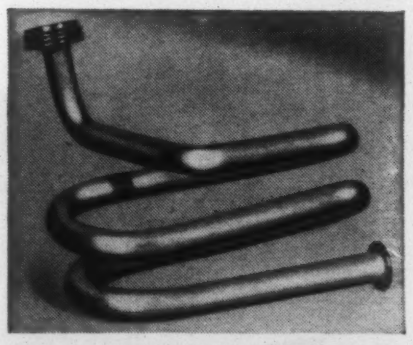
Pittsburgh Commercial Heat Treating Co.
49th and A.V.R.R. Pittsburgh 1, Pa.

STOP CORROSION LOSSES...

Caused by Sulfuric, Nitric, Phosphoric Acids

Specify parts made of ILLIUM

. . . the corrosion, erosion and heat resistant alloy



Shown above is ILLIUM welded tubing. This small-diameter tubing is easily bent and flared to exact tolerances. It may be welded to itself or other metals, and retains its bright finish in service.

The ILLIUM Utility Pump
A rugged pump designed for laboratory, pilot plant, and small industrial applications. Made entirely of ILLIUM, it will not contaminate material being pumped, and will often outlast stainless steel pumps as much as 5 times. Write for catalog information.

Critical processing operations involving corrosive liquids and gases have proved Illium's ability to slash replacement and maintenance costs down to a minimum.

Unequalled in resistance to attack by all concentrations of sulfuric acid, at virtually all temperatures, Illium is similarly well-suited to handling nitric, phosphoric, and mixed acids, and many acid-salt solutions. Over the years, it has firmly established its superiority over other alloys in the chemical, drug, petroleum, and food industries.

Available in castings up to 575 lbs., Illium is easily machined and welded. Samples for testing and investigation will be sent on request.

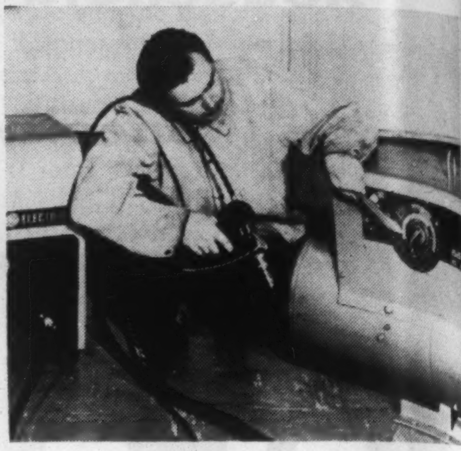
Write for Bulletin 651 for complete data.

THE ILLIUM CORPORATION, FREEPORT, ILLINOIS
Makers of Special Alloys and Quality Castings for Industry

For more information, turn to Reader Service Card, Circle No. 456

New Materials and Equipment

Consumable Electrode Inert Gas Welding Unit



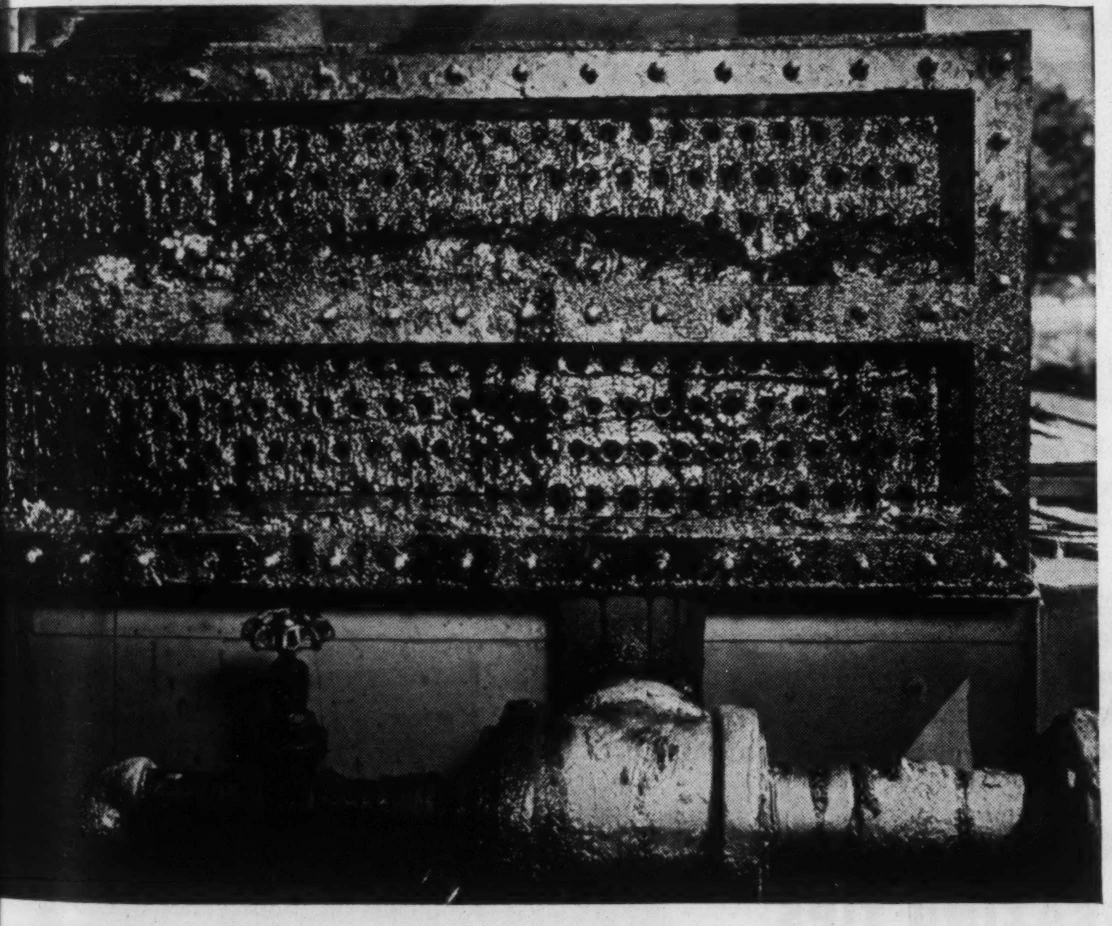
In the field of gas-shielded welding, a new consumable-electrode welding unit is said to allow the doubling of production output where filler metal must be added. The manufacturers claim their equipment simplifies control, decreases operator training time, and reduces operating and maintenance costs. The Fillerarc apparatus, developed by *General Electric Welding Dept.*, Schenectady, may be used in down-hand, vertical, or over-head positions to weld aluminum of any alloy in thicknesses from 1/32 to 3 in., and stainless steel from 1/16 to 1 in. It is also suitable for welding aluminum-bronze, nickel, and magnesium. Electrode wire of aluminum, stainless steel, mild steel, copper, magnesium, and other alloys may be employed with argon or helium shielding gas.

The Fillerarc unit consists of three main components: a self-regulating motor-generator type welder, a pistol shaped holder, and an electronic wire-drive unit.

The generator, rated at 450 amp, has a rising volt-amp characteristic which makes the process self-regulating. Designed to give constant arc length, the welder produces any current required up to its full rating, and is said to be capable of melting off the wire at any speed of feed. Once arc length is set, the operator can change the wire feed rate while welding without readjusting the welder. G-E engineers say that the Fillerarc's open-circuit voltage, between 10 and 30 v, will not sustain long arcs, reducing the possibility of burn-back.

The Fillerarc gun has a trigger to control wire feed and gas flow, an electrical contact tip, and knurled feed rolls which pull the electrode wire from a spool mounted in the wire drive unit. The water-cooled gun has a rating of 400 amps continuous d.c. and is capable of

THIS PLANT QUENCHES ALL TYPES and sizes of automotive and aircraft forgings. Sun Quenching Oil Light serves all five of the 2400-3000 gallon systems. In the seven years the shop has been using this oil, no unit has been down except for normal mill scale removal.



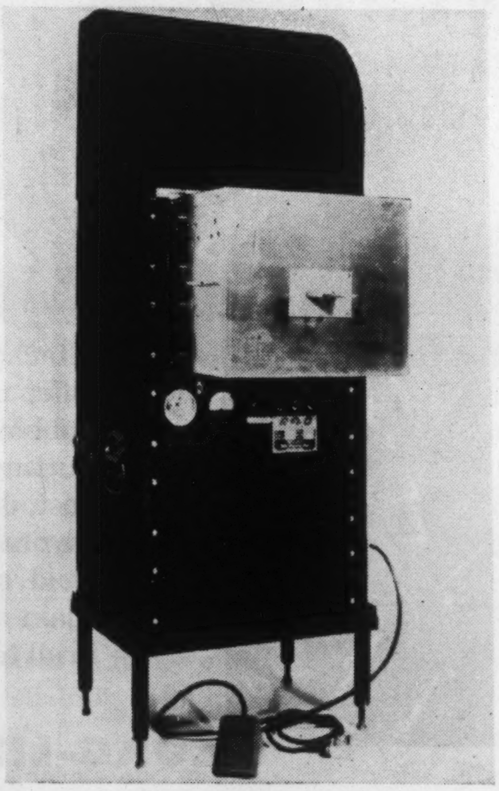
AN OIL THAT FORMS SLUDGE CLOGS oil coolers, increases maintenance and operating costs. Sun Quenching Oils have a natural detergency which helps keep the systems clean and removes any deposits that may exist.

INDUSTRIAL PRODUCTS DEPARTMENT
SUN OIL COMPANY
SUNOCO
PHILADELPHIA 3, PA. ◆ SUN OIL COMPANY LTD., TORONTO & MONTREAL

For more information, turn to Reader Service Card, Circle No. 326

feeding wire from 0.030 to 0.093 in. in dia with no special temper required. The wire feed speed can be adjusted from 0 to 750 in. per min by means of a remote, two-speed switch, the set being held constant by an electronic motor control in the wire drive unit. The gun weighs approximately 50 oz and the trigger is not held depressed during welding.

The wire drive unit is mounted on a portable carriage and contains a G-E Thy-mo-trol motor control which powers the feed rolls in the gun through a flexible shaft. It incorporates a voltmeter for indicating wire feed speed in in. per min as well as arc voltage, a gas solenoid valve, control relays, and a spindle for the electrode wire. The spindle handles spool or rim-wound wire up to a mile long and has a solenoid brake that prevents over-running of the reel and entanglement of the wire when not welding. Enclosed in a steel cabinet, the wire drive unit operates on 220 v, single phase, 60 cycle power.



Induction Soldering Machine

An induction heating unit designed specifically for soft soldering and silver brazing has been marketed by *Radio Frequency Co.*, Medfield, Mass. Model 5000 "RF Heater" incorporates a circuit and output transformer arrangement which permits high, no-load circulating currents in the work coil. This allows the use of single turn or half turn work coils which the operator of the work can safely touch during operation, per-

BRAZING "BOATS" and TRAYS

The ideal way to hold parts or assemblies in place for brazing is to place them in specially designed "boats" or trays of Stackpole carbon. Almost any desired shape or size can be supplied. Brazing alloys will not stick to them. The trays withstand severe thermal shock, thus permitting quick cooling of brazed parts. Write for Catalog 40A.

STACKPOLE
Carbon-Graphite

FASTER, BETTER ARC WELDING

Stackpole carbon and graphite welding rods offer many advantages over metal rods for jobbing or building up metal, and often for cutting. These include higher speed, lower cost, deeper penetrations, generation of more favorable atmospheric conditions around the weld spot and hotter, more efficient arcs. Plain and copper-coated types are available in all tapers and sizes. Write for Catalog 40A.

LONG-LIFE RESISTANCE WELDING and BRAZING TIPS

Where heat is conducted to the work between tips; where one component of a weld is melted or an alloy solder introduced to complete the bond, Stackpole brazing tips with the famous anti-oxidation "F" treatment give 4 to 5 times longer life than untreated tips! No mushrooming or sticking. Withstand radical temperature changes. Available in practically any size or shape. Write for Catalog 40A.

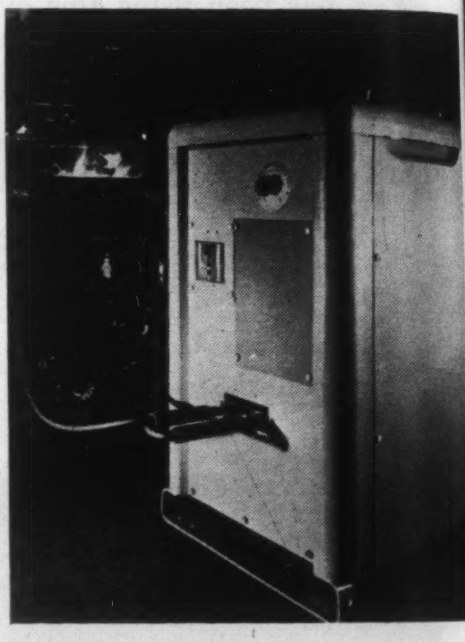
STACKPOLE CARBON COMPANY
ST. MARYS, PA.

For more information, turn to Reader Service Card, Circle No. 387

mitting rapid loading and high production.

The machine, which eliminates hand soldering, is particularly adapted to such operations as sealing of condenser cans, and on similar products such as relays, thermostats, crystals, resistors, transformers, etc., where hermetic soldering is required. It is also suited to soldering glass to metal terminals, and can be set up for a new job in a matter of minutes.

Features of the Model 5000 "RF Heater" include air cooled 10 kw oscillator tube, minimum cooling water for work coil, work coil located at table top height, and, at optimum working distance, small floor space requirements (18 by 26 in.). Rated capacity is said to be a full 5 kw output.



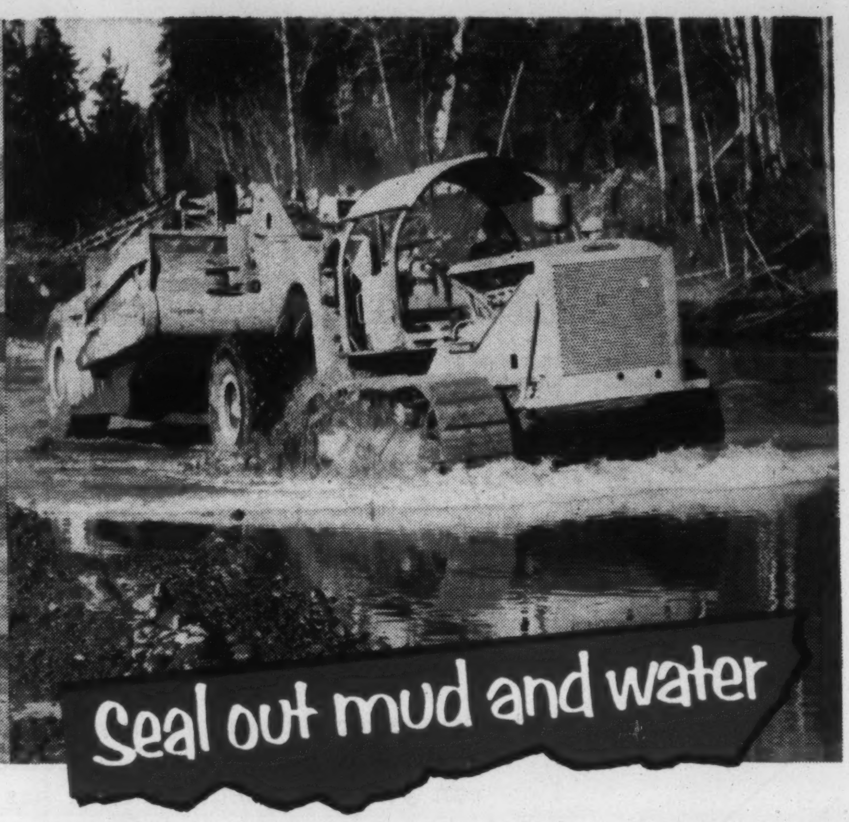
Light Weight Selenium Rectifier D. C. Welder

Materials selection and design improvements have resulted in the development of a comparatively small and light-weight addition to the line of selenium rectifier d.c. arc welders marketed by *Westinghouse Electric Corp., Motor and Control Div.*, Buffalo, N. Y. The new welder is said to incorporate all the characteristic advantages of static, plate-type rectifiers in addition to reduced weight and size, greater ease of maintenance and wider versatility and user convenience.

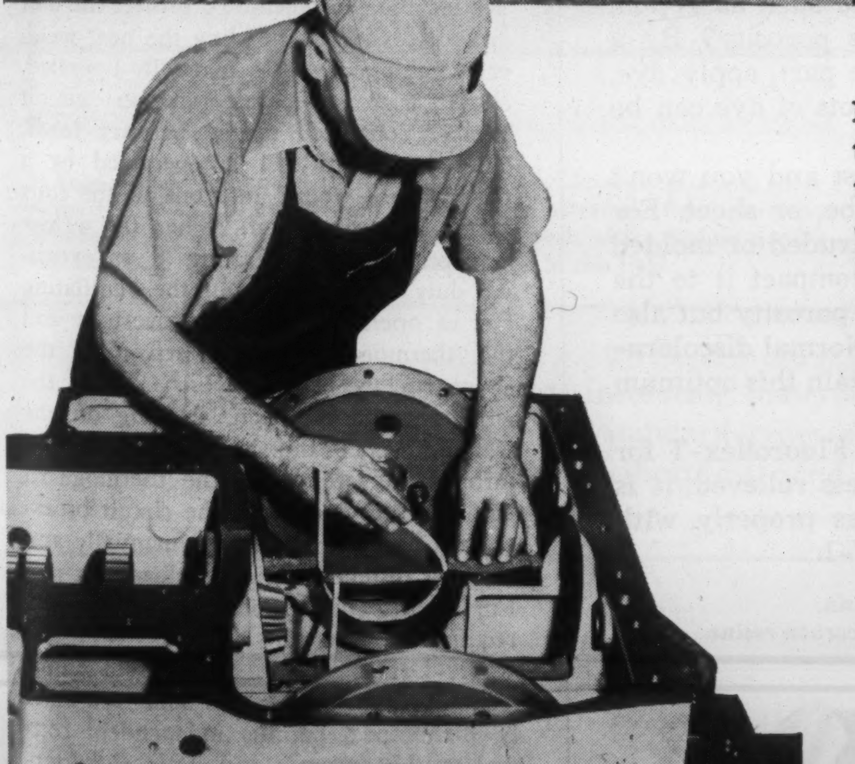
Consisting essentially of two parts, the heart of this new welder is made up of a three-phase, full-wave selenium rectifier, and a Transactor unit which is a combination three-phase transformer and movable core reactor. The Transactor unit has resulted in a smaller, lighter, more convenient current control and voltage step-down device. It has two, three-phase laminated cores; one is a fixed core

For TOUGH Sealing Jobs use American Felt!

Seal out dust and grit



Probably tractors encounter more severe operating conditions than almost any other piece of mechanical equipment, and for that reason it is vitally important to keep dust, grit, and water out of operating parts, and oil and grease in. Felt seals are ideal for this purpose, and American is proud to supply felt for sealing to Caterpillar Tractor Co., Peoria, Illinois. In these days of expanding construction, you will see Caterpillar-built machinery everywhere. Felt is in many of them, unseen, helping protect performance, reliability, and long life . . . American makes various types of felt for sealing purposes, and supplies it as desired, including gaskets and washers cut to size. For information, write for Data Sheet No. 11, "Felt Seals, Their Design and Application."



Installing a dust seal gasket between the castings in the bevel gear and steering clutch compartment of a Caterpillar track-type Tractor.

American Felt Company
TRADE MARK

GENERAL OFFICES: 24 GLENVILLE ROAD, GLENVILLE, CONN.

SALES OFFICES: New York, Boston, Chicago, Detroit, Cleveland, Rochester, Philadelphia, St. Louis, Atlanta, Dallas, San Francisco, Los Angeles, Portland, Seattle, San Diego, Montreal.—PLANTS: Glenville, Conn.; Franklin, Mass.; Newburgh, N. Y.; Detroit, Mich.; Westerly, R. I.—ENGINEERING AND RESEARCH LABORATORIES: Glenville, Conn.

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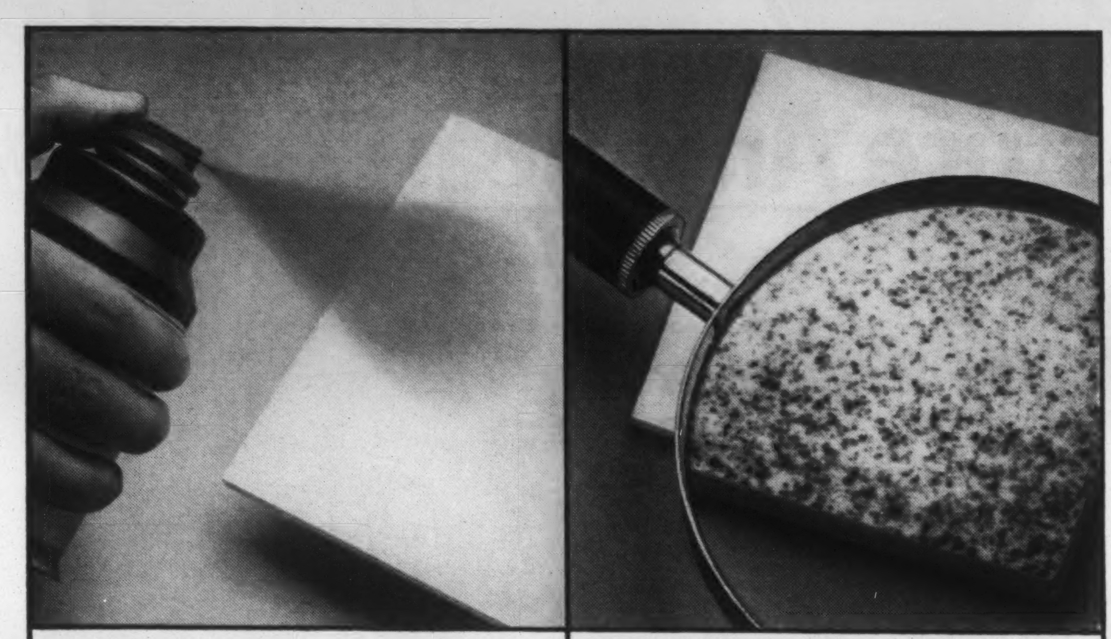
It pays to check TEFLON*

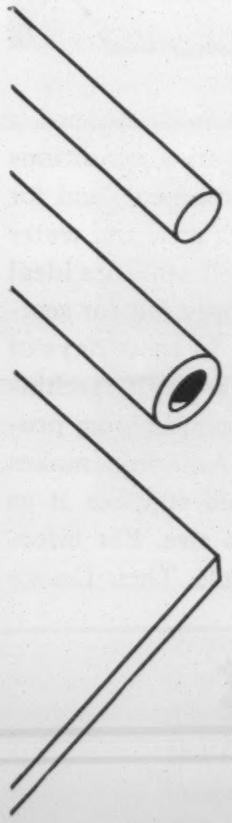
for non-porosity



Penetrating dye applied on cleaned Teflon part will penetrate wherever porosity exists.

Magnified section of porous Teflon part, even when wiped clean, shows telltale dye stains. You'll find no such dye penetration in Fluoroflex-T products.

Assure dielectric stability in parts by using non-porous **FLUOROFLEX®-T**



Porosity detracts from any insulating material – even from a virtually perfect UHF dielectric such as Teflon. How can you tell whether Teflon has porosity? By a penetrating colored dye test. Clean the part, apply dye, wipe off. When magnified, absorbed spots of dye can be plainly seen.

Put Fluoroflex-T products to the test and you won't find any penetration in either rod, tube, or sheet. For two reasons: (1) Teflon powder is extruded or molded on equipment especially designed to compact it to the critical density. This not only prevents porosity but also provides highest tensile strength. (2) Normal discolorations in Teflon are left unbleached to retain this optimum density.

That's why you can always count on Fluoroflex-T for electrical stability in severest use. Stress relieved, it is also dimensionally stable and machines properly with minimum rejects. Write for Bulletin FT-1.

**DuPont trade mark for its tetrafluoroethylene resin.*
® Resistoflex trade mark for products from fluorocarbon resins.

RESISTOFLEX
corporation
Belleville 9, N. J.

SPECIALLY ENGINEERED FLEXIBLE RESISTANT PRODUCTS FOR INDUSTRY

For more information, turn to Reader Service Card, Circle No. 365

on which the primary and secondary coils are wound, the other is divided into two parts—a stationary core, and a movable core.

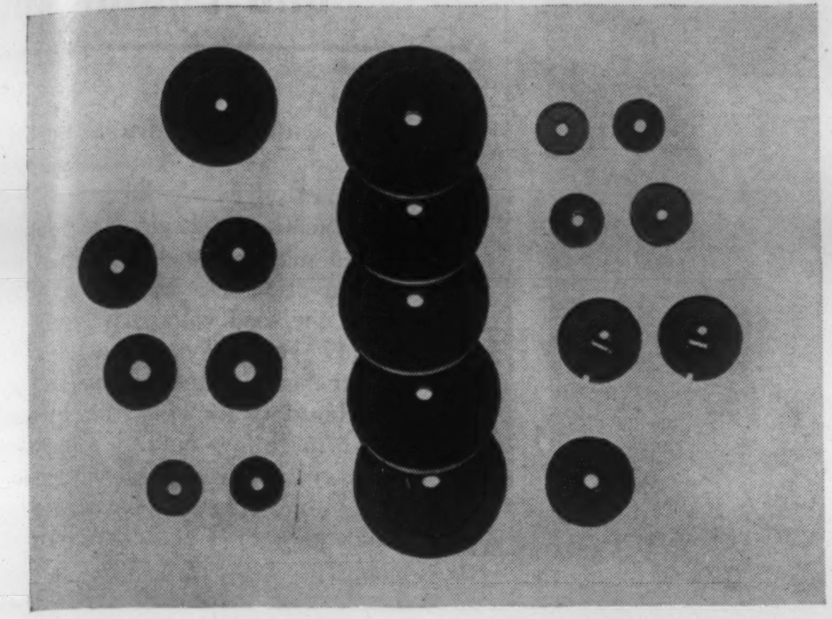
The movable core, the legs of which are linked by the common secondary and reactor winding, is supported by guides on the side members of the welder. Two acme screws supported by the stationary core section drive the movable core by means of a hand crank on top of the welder. Maximum current is obtained when the movable core is at the greatest distance from the stationary core, and minimum current is obtained when the movable core is close to the stationary core.

One of the greatest innovations in this welder is the fact that the coils are made of aluminum. Through proper design it was found that Class B insulated aluminum conductors produce operating characteristics equal to copper coils. They also have distinct advantages over copper coils in that the use of aluminum conserves critical copper and reduces coil weight by a ratio of about 2 to 1, where one copper coil will just balance two aluminum coils. This has resulted, for instance, in the reduction in weight of a 300-amp welder from 510 to 400 lbs.

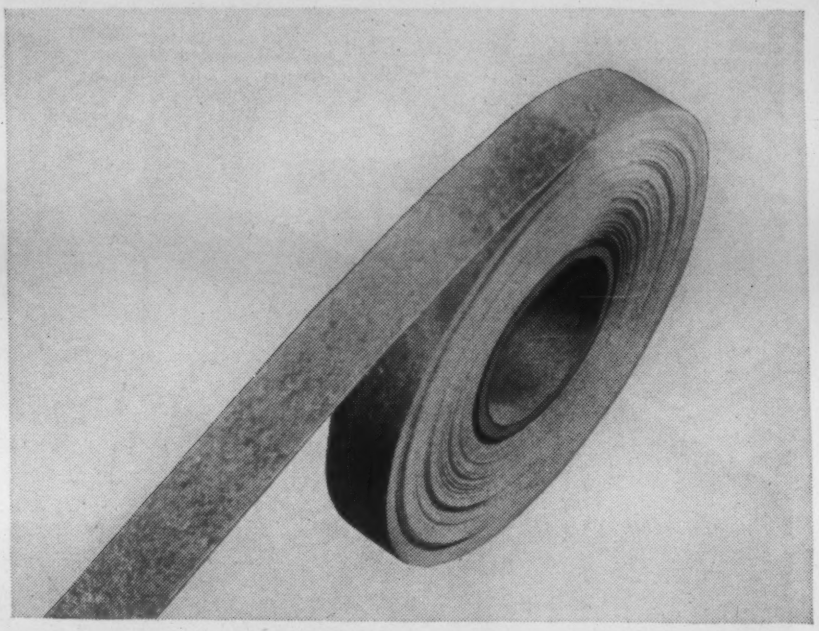
Since arc welding machines are designed on a duty cycle basis and will develop from 10 to 125% or more of their rated current output, there is always the possibility of overloading and overheating the equipment. To protect the unit from excessive overloading the new welder is equipped with a manually operated, shunt trip, three-pole, de-ion circuit breaker connected to the primary leads. The shunt trip coil is energized by a thermoguard wound into one of the coils of the Transactor unit. When the welder is overloaded by operating at an excessive duty cycle or without the ventilating fan in operation, the coils overheat and the thermoguard closes, activating the shunt-trip mechanism which causes the circuit breaker to open, shutting off the welder. When the coil temperature returns to a safe value, the thermoguard automatically opens and the circuit breaker may be reset and closed manually and welding resumed. This overload mechanism affords equal protection to both the rectifier and the coils.

Arc Drive Control, designed to eliminate shorting out where a short arc must be maintained, permits independent control of the dynamic and static characteristics of the welder by varying the ratio of short-circuit current to welding current. When the arc begins to short out, the Control supplies instantaneous current surges which clear the shorts and reestablish the welding arc, resulting in

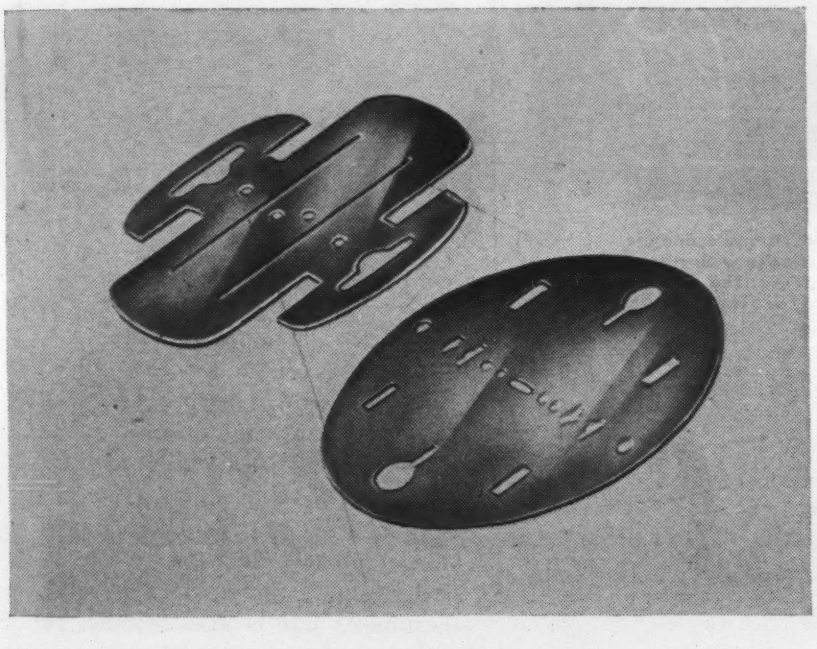
Do you have any of these problems?



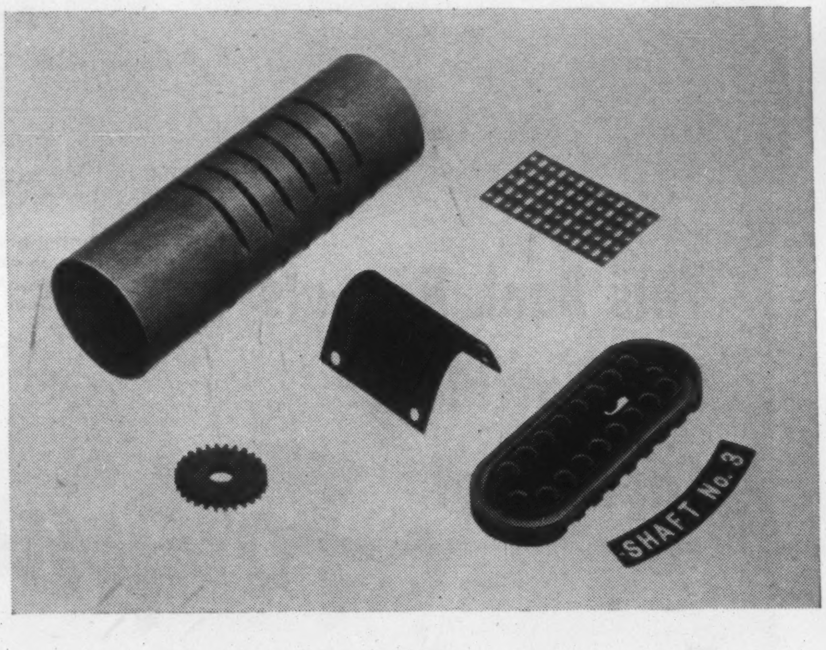
1. Need a combination of gasket sealing and mechanical and electrical properties? Various grades of LAMICOID®—laminated plastic made with organic and inorganic binders—are combined with natural or synthetic rubber to obtain the excellent insulating and mechanical properties of LAMICOID and the sealing properties of rubber.



2. Need a mica tape that can be run on taping machines at high speed? ISOMICA* tapes are made from long rolls of thin continuous mica sheet... are more uniform in mechanical and dielectric strength... have no high spots or voids. For electrical insulation of class B or class H motors, generators and transformers.



3. Need accurately punched mica stampings for filament, grid and plate supports? MICO produces mica stampings to extremely fine tolerances. Whenever you need precision-fabricated mica parts of the highest quality, call on MICO. We have 60 years of experience in this field.



4. Need special mechanical and electrical properties for brackets, terminal blocks, access panels, etc.? LAMICOID® is half as heavy as aluminum and, weight for weight, stronger than steel. Offers high impact strength, high dielectric strength, excellent abrasion and moisture resistance.

Whatever electrical insulating materials you need, MICO makes them best. We manufacture all standard types and many special materials, and fabricate parts to your specifications. Send us your blueprints or problems today.

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1893-1953
60 Years
of Leadership
in Electrical
Insulation

MICO ELECTRICAL INSULATION

MICA *Insulator* COMPANY

Schenectady 1, New York

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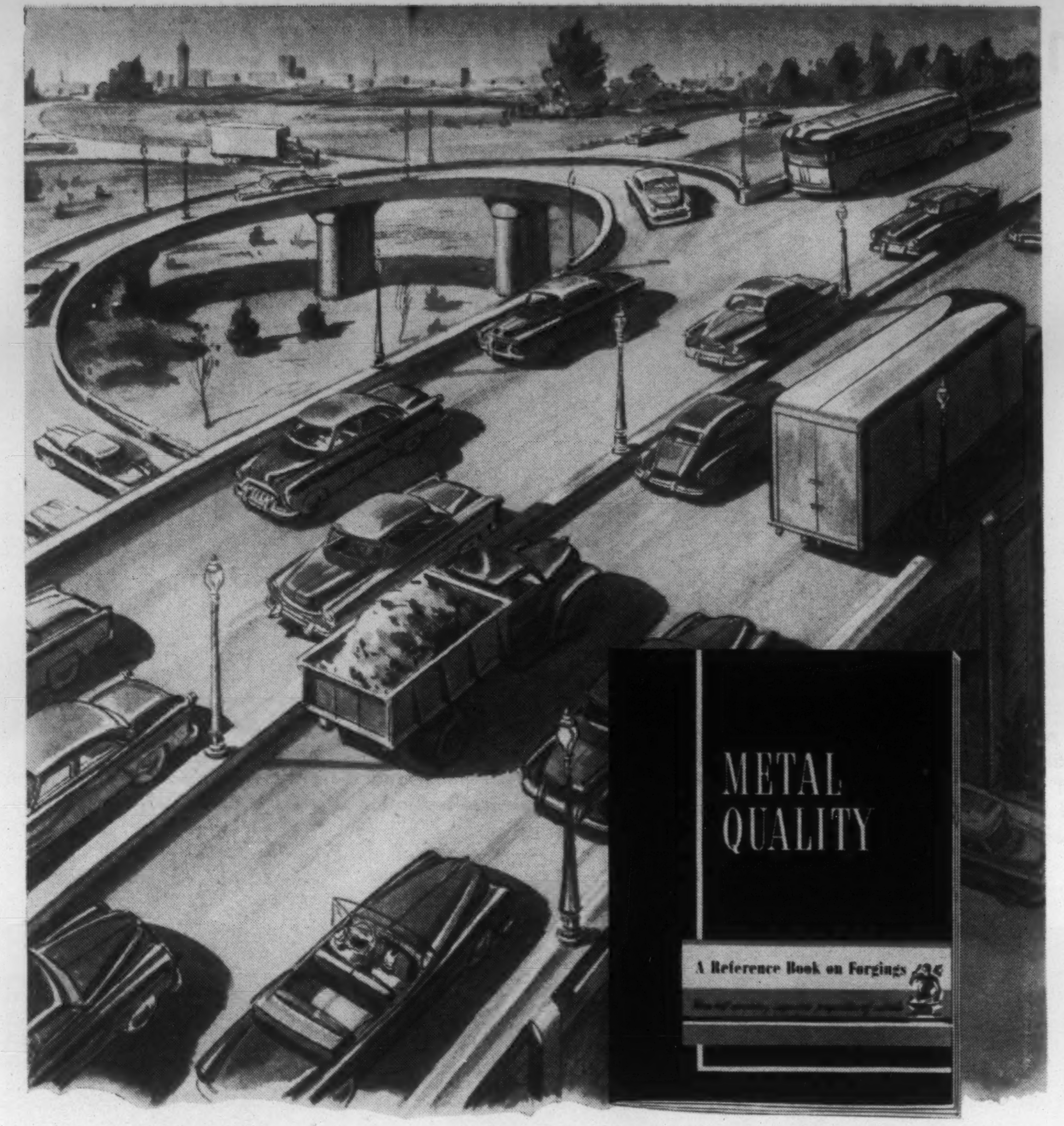
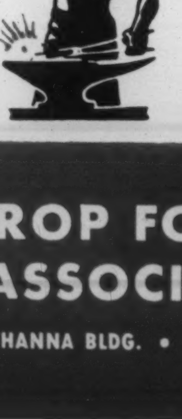

METAL QUALITY
A Reference Book on Forgings

Engineering, production and economic advantages obtainable with closed die forgings are presented in this Reference Book on Forgings. Write for a copy.

This Book Reveals the Matchless Capacity of Forgings!

That makes possible Modern Transportation

What a forging *has*—can't be duplicated! No other method of fabricating parts utilizes fully the fiber-like flow line structure of wrought metals. Now is an excellent time to check your product for cost reductions—to explore possibilities for improving performance—to reduce dead weight. Check problem parts with the unrivaled advantages of closed die forgings and the closed die forging process for producing parts. Double-check all parts, particularly those which are subjected to great stress and strain. Then consult a Forging Engineer about the correct combination of mechanical properties which closed die forgings can provide for your product.



DROP FORGING ASSOCIATION
605 HANNA BLDG. • CLEVELAND 15, OHIO

Please send 64-page booklet entitled "Metal Quality—How Hot Working Improves Properties of Metal", 1953 Edition.

Name ....
Position ....
Company ....
Address ....

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New Materials and Equipment

arc stability with improved weld quality. As soon as the welding arc voltage falls below the critical point, the Arc Drive circuit automatically begins to supply current, and increases this current as the load voltage decreases, reaching a maximum when the load voltage is zero.

Axial flow ventilation is used on the unit with the fan located on top and air intake at bottom, allowing the upward flow of air to follow natural convection resulting in maximum cooling with minimum size cooling fan and motor.

Although the three standard units of the welder are of the 200, 300, and 400 amp size, Duplex models are available in 300/600 and 400/800 amp ratings. The Duplex unit consists of two single units mounted on a common bedplate and enclosed in a single case. These units can be used as two single units or paralleled by joining the secondary leads to produce a unit with twice the single unit current rating.

Aluminum Fluxes: Paste and Powder

Two non-corrosive aluminum soldering fluxes, one a paste the other a powder, have been marketed by *Fim, Inc.*, 170 Fifth Ave., New York. Flux #18 (paste) is designed to solder aluminum with tin, lead, zinc, cadmium and their alloys. Any plain solder, torch, or soldering iron can be used.

Flux #24 (powder) solders all commercial metals such as steel, stainless steel, copper, brass, nickel, silver and aluminum, and is also suitable for dip-soldering. It is said to produce good results soldering with pure tin on sheet titanium.

The two fluxes are available in bulk for industrial consumers as well as in 1 oz jars for the hardware and do-it-yourself trade. The company states also that it is equipped to develop other fluxes for special situations.

Rods for Cast Iron and Alloy Steel

Three new welding rods have been added to the line of *Eutectic Welding Alloys Corp.*, 40-40 172nd St., Flushing, N. Y.: two for oxy-acetylene welding of cast iron, one for arc welding of alloy steel.

EutecRod 143FC is said to combine dense welds and high tensile strength with improved weld appearance for the low temperature welding of cast iron. It does not require fusion temperature in

STYRON FORMULATIONS OFFER A CHOICE OF END-USE ADVANTAGES

If your requirements include toughness, excellent mechanical properties, wide color range... select STYRON formulation 475

Coca-Cola
Coke
SERVE ICE COLD

Styron® 475 is a lightweight, rigid thermoplastic—five times tougher than regular grades of polystyrene—with low moisture absorption. It is especially applicable to items, such as attractive bottle carriers, that must offer resistance to rough use as well as colorful point-of-sale appeal. The economy of this formulation, its moldability and its ability to be cleaned for re-use suggest many similar applications.

In addition to Styron 475, Dow offers a variety of polystyrene formulations that cover a wide range of characteristics. *STYRON 700* is a high heat-resistant polystyrene that completely fulfills the requirements of low cost, easy extrusion with high surface gloss and ability to hold close dimensional tolerances. *STYRON 637* is a light-stabilized grade of polystyrene that readily finds application in lighting fixtures. *STYRON 666* is an excellent general-purpose polystyrene developed to provide maximum property values in the end product with maximum ease and speed of fabrication. *STYRON 777* is a medium impact polystyrene with desirable cost and fabrication advantages.

A number of technical service bulletins are available for more detailed information on the Styron formulations. For details, write THE DOW CHEMICAL COMPANY, Midland, Michigan, Plastics Department PL 1382A.

you can depend on DOW PLASTICS

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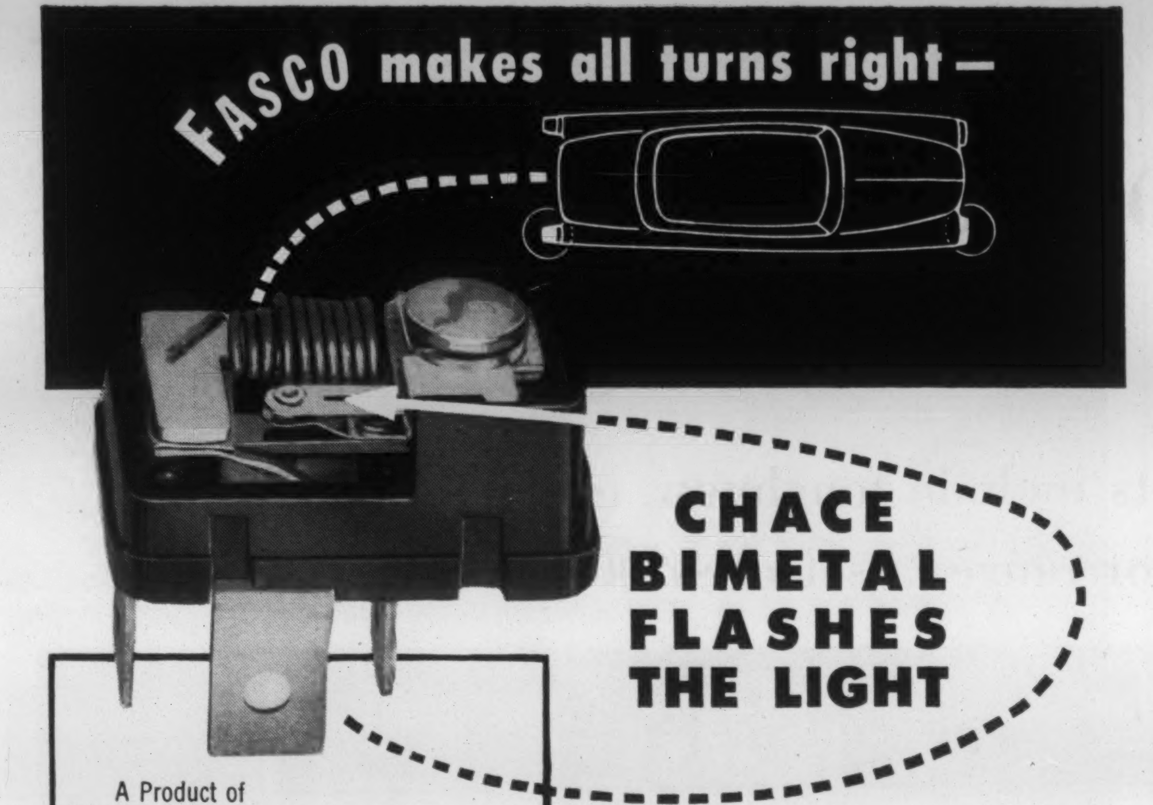
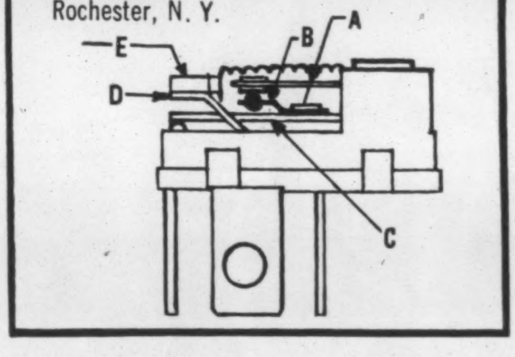


A Product of
Fasco Industries, Inc.
Rochester, N. Y.



The Fasco Flasher is the switching unit which blinks the front and rear signal light, and a dash pilot light, on modern automobiles to indicate when a turn is about to be made; a big factor in safety and peace of mind on the highways. Fasco flashers are installed as original equipment in many leading makes of cars and trucks.

Heart of the Fasco flasher is a Chace Thermostatic bimetal element which serves a dual purpose—making and breaking the signal light circuit and also protecting the wiring from short circuits and overloads.

In the illustration, the slotted element (A) closes the signal circuit contacts at (B), magnetically energizing frame (E) which pulls up armature (C) against pilot contact (D), lighting the dash pilot light and adding to the upward pressure on blade (A). Signal lamp current flowing through blade (A) causes it to heat and bend upward, breaking the lamp circuit and allowing (B) and (C) to fall and break the pilot light circuit. As (A) cools and touches (B) again, the cycle repeats.

Chace Thermostatic Bimetal is precision manufactured in 29 types, in strips, coils, random long lengths and welded or brazed sub-assemblies. Before proceeding with the design of your new actuating device, consult our application engineers, recognized authorities on temperature responsive devices—or write today for our 32-page booklet "Successful Applications of Chace Thermostatic Bimetal," containing condensed engineering data.

W. M. CHACE CO.
Thermostatic Bimetal
1615 BEARD AVE., DETROIT 9, MICH.

For more information, turn to Reader Service Card, Circle No. 532

New Materials and Equipment

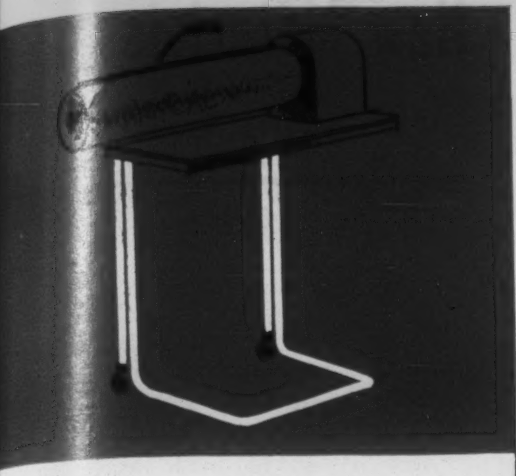
the base metal to effect the bond, but will flow at a base metal heat of approximately 1450 to 1650 F thereby minimizing the dangers of warping, stress and embrittlement commonly encountered with high heat welding of this metal. A new coating on the rod is said to give smooth, clean welds, permitting applications in railroad work, glass mold work, machine building work, and similar operations where appearance is important. EutecRod 143FC is available in square shape in 3/8, ¼, 3/16 and ⅛ in. sizes.

EutecRod 113 is also a low melting point alloy designed, however, for sealing cracks and porosity and for the building up of cast iron. Similar to EutecRod 15, the new product is said to provide quicker tinning action, lower bonding heat, longer working range and easier spreading. The rod is used with Eutector Flux 115 in paste form, permitting "painting" on the part to be worked. Although primarily designed for cast iron, EutecRod 115 can also be used on bronze, steel castings, and for filling and bonding any metal except aluminum and magnesium. It is available in a full range of sizes.

EutecTrode 69AC and 690-DC are particularly recommended for the joining of light sections of low and medium alloy steels and stainless steel types 301, 302, 320B, and 303. The manufacturer claims that these products offer greater alloy deposition per electrode, produce smooth running deposits of excellent appearance, and permit swift, easy slag removal. Applications cited are in the welding of alloy and stainless steels in architectural applications and the welding of low-alloy, high-strength proprietary steels used in railroad cars. The new products are also said to produce quality protective overlays where resistance to heat and/or wear are important, such as rebuilding of worn alloy steel shafting and repair of clutch and brake friction disks or plates. The electrodes are available in 3/32, 5/32 and 3/16 in. sizes.

High Weld Strength Claimed for New Adhesive

A new adhesive for joining similar or dissimilar metals or other materials is said to apply easily, set quickly, and produce a bond with a strength of 3,000 psi. Marketed by *Miracle Adhesives*



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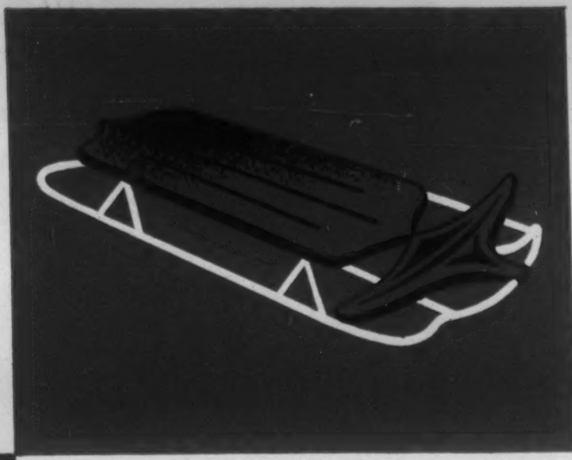
is versatile!



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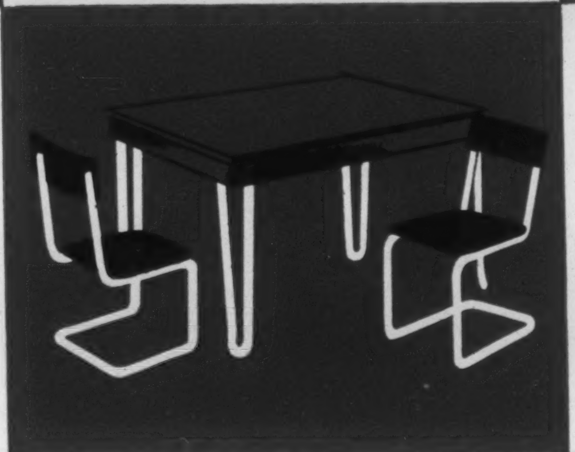
is versatile!



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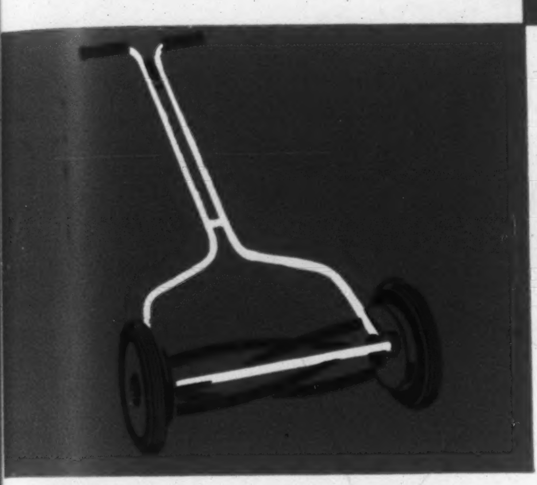
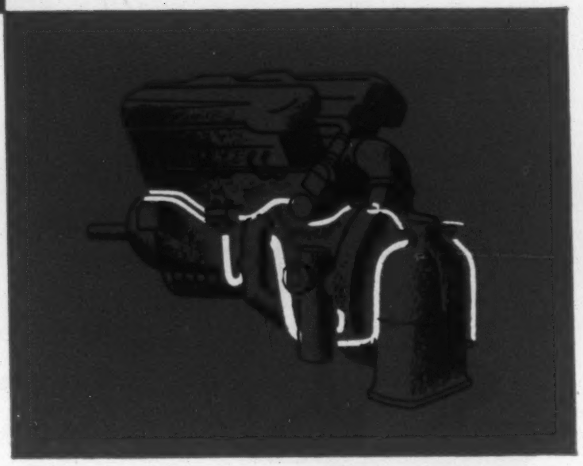
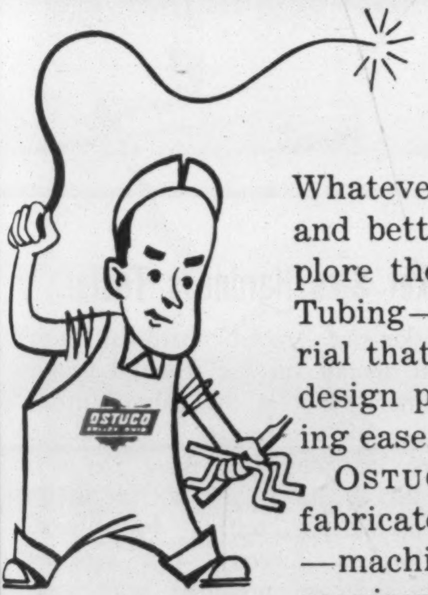
TUBING
is versatile!



OSTUCO
TUBING
is versatile!



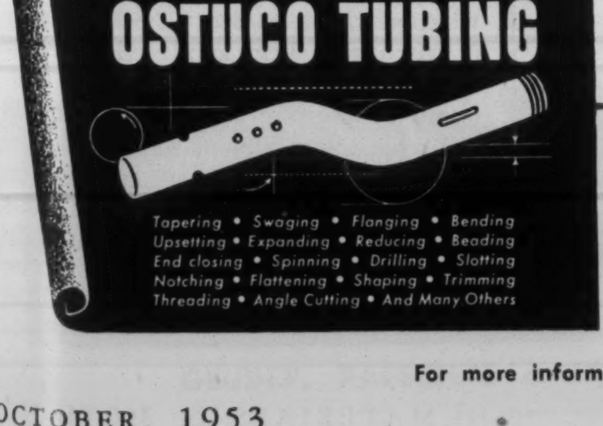


whips new ideas into shape

Whatever your ideas for creating new and better products, it will pay to explore the many advantages of OSTUCO Tubing—the strong, light-weight material that whips even the most stubborn design problems into line with surprising ease.

OSTUCO TUBING can be forged or fabricated beyond recognition as a tube—machined and finished to your exact requirements—quickly joined in assemblies by a large variety of mechanical or welding methods.

Modernized and greatly expanded facilities for *manufacturing, shaping,* and *fabricating* tubing, all at one plant—plus our own steel source as a member of the Copperweld family—enable OSTUCO to speed deliveries, assure uniform high quality, and cut your final costs. Write for informative booklet "Fabricating and Forging Steel Tubing."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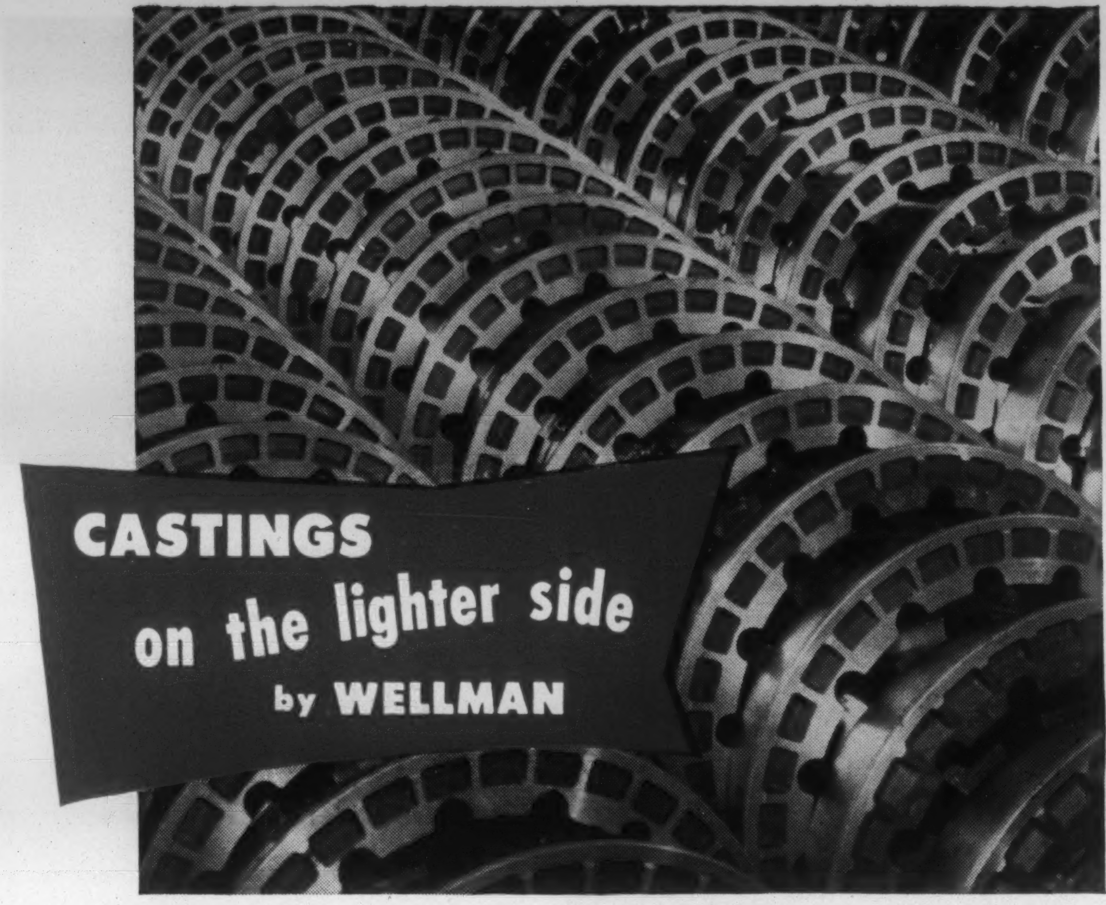

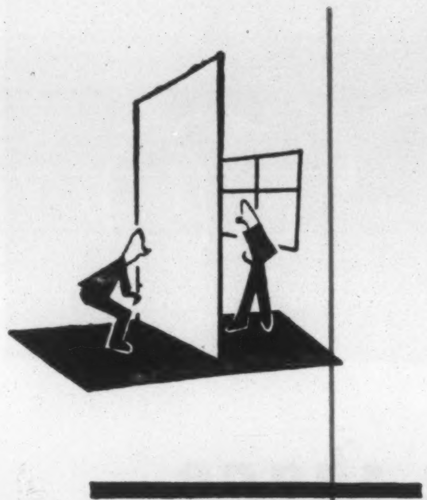

If you're thinking along the lighter side about the whole subject of magnesium and aluminum castings, think about Wellman as a source.

As the contractor, standing in one room of his new inexpensive house, said to a friend in the next room, "You can *hear* me, but you can't *see* me? Them's some walls, ain't they!" . . .

"Them's some walls" on a Wellman lightweight magnesium casting, too, thin in appearance but tough enough for our biggest jet bomber landing wheels . . . and easy to machine!

Let us show you how our four complete plants and almost a half century of experience can help you. Write for our new catalog No. 53.

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THE WELLMAN BRONZE & ALUMINUM CO.
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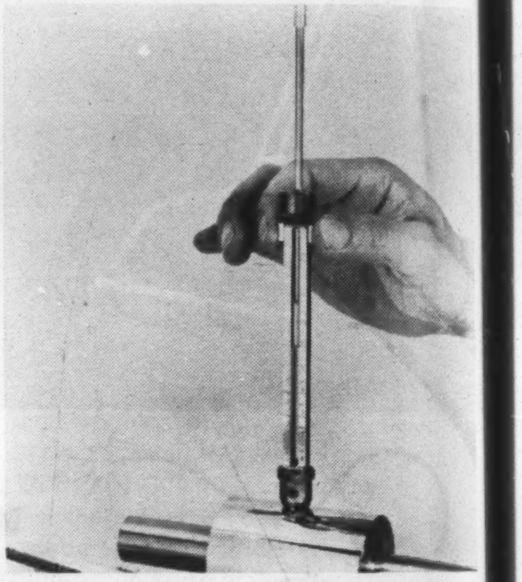
New Materials and Equipment

Corp., 214 E. 53 St., New York, the product, Adeweld, is non-flammable, therefore particularly applicable for use where fire hazards preclude welding.

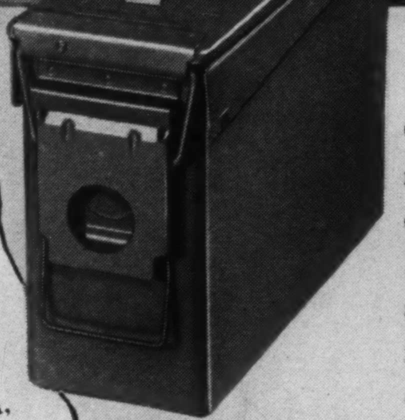
Adweld can be made to set in 10 min, and only clamps are required for successful joining. The manufacturer states that manufacturers of airplane parts, toys, appliances and other industries where metals and other materials are joined, will be able to effect savings in labor and materials through the use of this adhesive.



Pocket Size Hardness Tester

Pocket-size metal hardness testers, which operate on the rebound principle, combine low cost and simplicity with accuracy of test results. The Sklerograf testers, distributed by *Kurt Orban Co., Inc.*, 205 E. 42 St., N. Y., are designed for on-the-spot testing by engineers, metallurgists, foremen and superintendents, and are provided with tubular nickel containers for ease of carrying while on the job.

When testing, the instrument is placed in a vertical position on top of the article to be tested, and the rebound bar which carries a hardened steel ball point is raised until held in place by the lock device. When this locking device is released by pressing a catch, the bar falls and rebounds to a point corresponding to the hardness of the object. Hardness can be read within an accuracy of 1 point Rockwell C, by noting the position of the indicator ring on the hardness bar against the graduated scale. Conversion tables



G.P. & F. Produces 1,000,000th Ammunition Box

The Sheboygan, Wis., plant of Geuder, Paeschke & Frey Co., recently celebrated the completion of the one-millionth .30-cal. ammunition box it is now producing for the government. Shown in the photo above are, left to right: William Livingston, Assistant Chief of Purchasing, Chicago Ordnance District; Frank T. Frey, G. P. & F Executive Vice-President; Major E. A. Smith, personal representative of Colonel Haskell, Commanding Officer, Chicago Ordnance District; August K. Paeschke, G. P. & F. President; Major R. E. Ryan, Commanding Officer Milwaukee Regional Office, Chicago Ordnance District. G. P. & F.'s Sheboygan branch plant is devoted entirely to military production.

• Whether your requirements are for military use or civilian use—whether you need an ammunition box or a washing machine tub—if it's stamped or drawn, chances are that G. P. & F. can do it for you. When you think of G. P. & F., think of over 1000 skilled people . . . 15 acres of production facilities . . . 293 deep draw and stamping presses . . . 97 welding machines . . . a complete tool and die department.

METAL STAMPINGS FOR EVERY TYPE OF CIVILIAN AND MILITARY USE

Automobile Oil Pan
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Seamless Drawn—
Vitreous Enameled

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Seamless Drawn Steel

Aerial Delivery Container
U. S. Air Force

Deep Fat Fryer Pot
Stainless and Carbon Steel

Scale Platter
Vitreous Enameled

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Stainless Steel

Tub and Cover for Portable Dishwasher
Seamless Drawn Aluminum—
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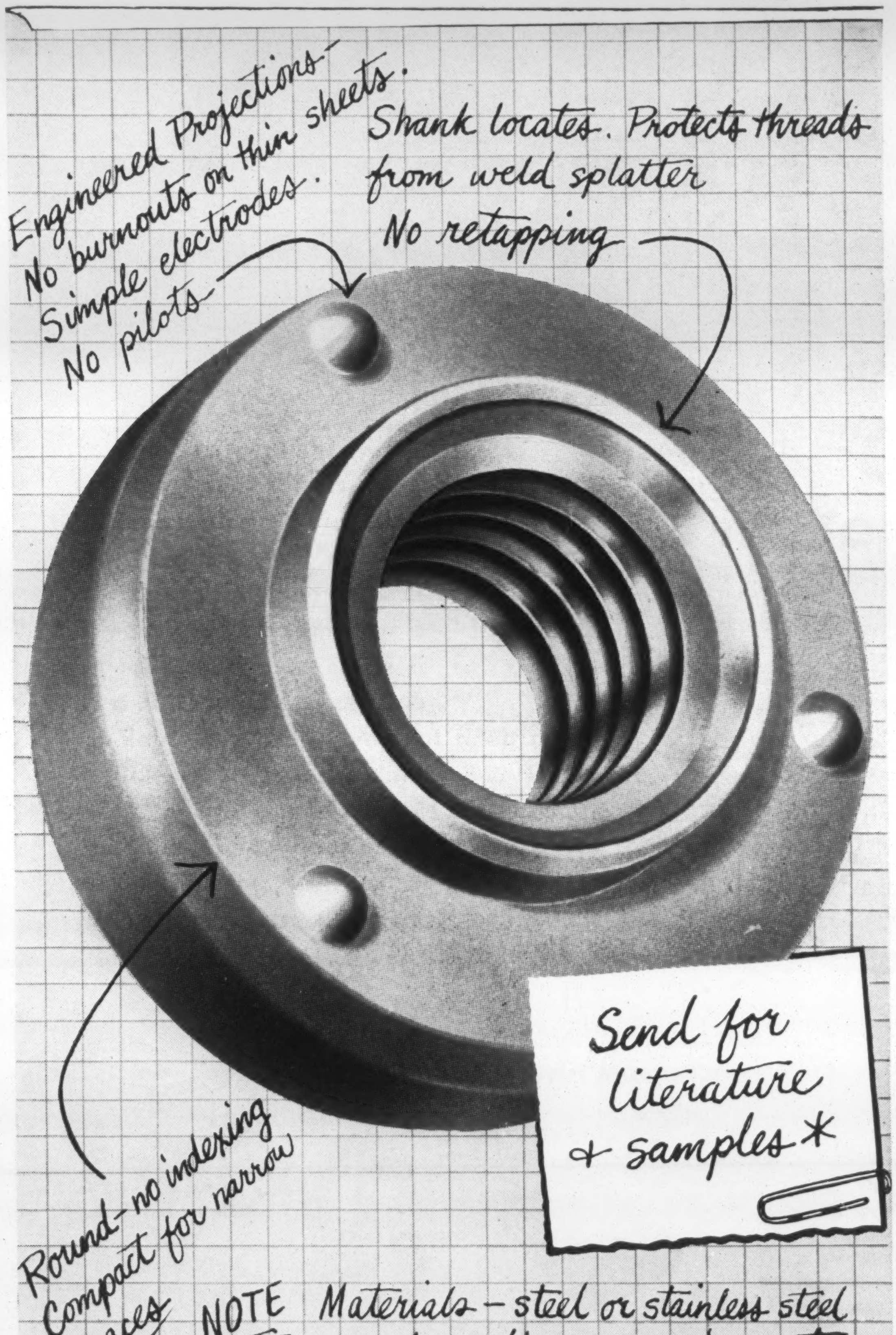
MAKE SENSE because
they SAVE DOLLARS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Engineered Projections–
No burnouts on thin sheets.
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from weld splatter
No retapping
Round–no indexing
Compact for narrow
spaces
Send for
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NOTE Materials–steel or stainless steel
depending on requirements.

* Penn Engineering & Manufacturing Corp., Doylestown, Pa.

PEM

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supplied with the Sklerograf permit quick conversion of the scale reading to Shore, Rockwell C, Rockwell B or Brinell hardness.

New Carbide Grade for Heavy Roughing Cuts

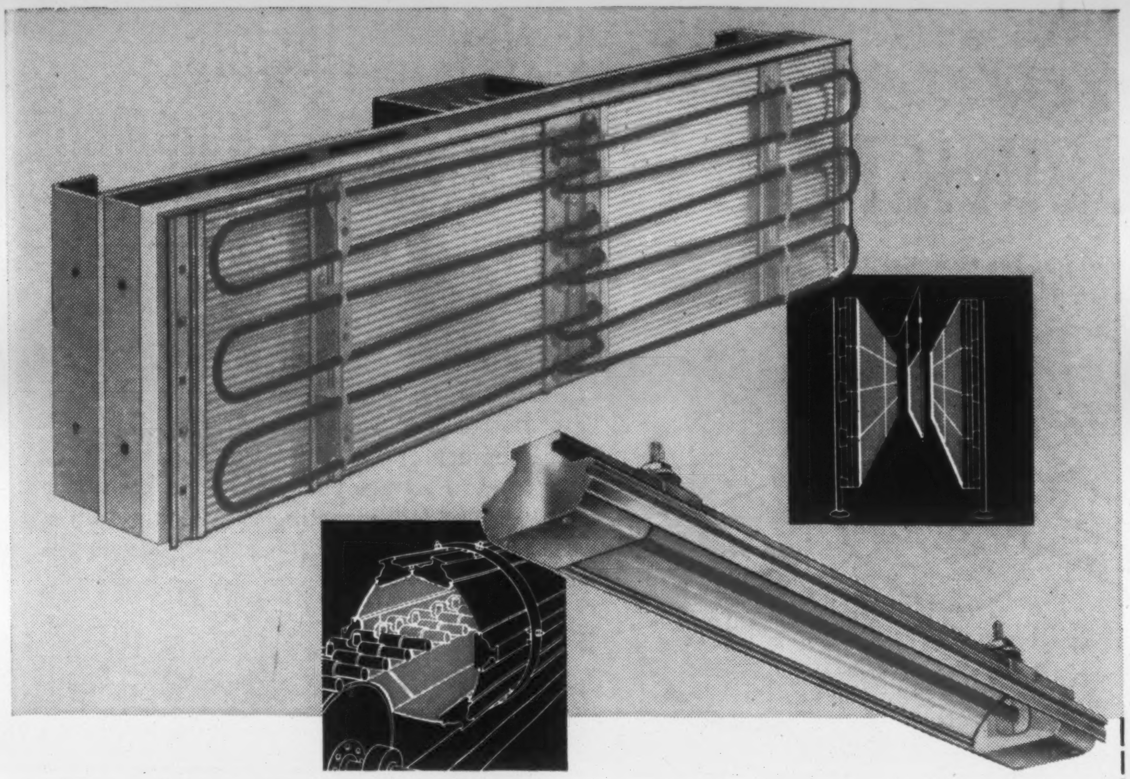
A new grade of carbide has proven to be particularly suited to rough turning of all types of steel and armor plate, and the manufacturer claims that for this purpose, it is far superior to any other grade on the market today. Developed by the *Adamas Carbide Corp.*, Harrison, N. J., Adamas Grade 434 has been used on certifugally cast 309B stainless steel and is said to have out-performed the usual straight tungsten carbide grades normally used for this material. Feeds ranging from 0.015 to 0.068 in. per revolution and speeds from 68 to 600 surface ft per min have given good results, while the depth of cut used was $\frac{1}{8}$ to $1\frac{1}{4}$ in.

File-Hard Coating for Aluminum

A new process for hard-coating aluminum is said to produce a surface with high resistance to abrasion and corrosion, a high dielectric strength, and low coefficient of friction. The Martin Hard-Coating Process, licensed by Alcoa to *Anodic, Inc.*, Salt St., Bridgeport, Conn., is an anodic treatment that is said to produce an amorphous coat of aluminum oxide about ten times thicker and 30 to 100% harder than other anodizing processes.

The coating, generally 0.002 in. thick, grows equally above and below the original aluminum surface, increasing sheet thicknesses 0.001 in. or tubing dia 0.002 in. The buildup is said to be consistent and can be controlled within close tolerances.

The company states that most alloys of aluminum are suitable for the MHC Process, though in general it is best applied to those containing less than 5% copper or 8% silicon. The coating can

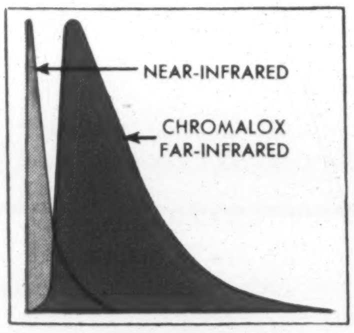


CHROMALOX *Far-infrared*

solves hundreds of heating problems

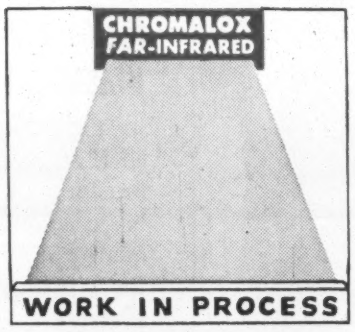
Here's your quick, economical and easy solution for curing, drying, degreasing, dehydrating, baking and other heating jobs. Pre-engineered Chromalox Units make oven building as simple as A-B-C, generate uniformly absorbed far-infrared heat for a multiplicity of processing needs. Temperatures up to 700° F. are easily selected, accurately maintained. Low initial cost, low write-off cost, low operating cost!

ONLY CHROMALOX GIVES YOU ALL THESE ADVANTAGES



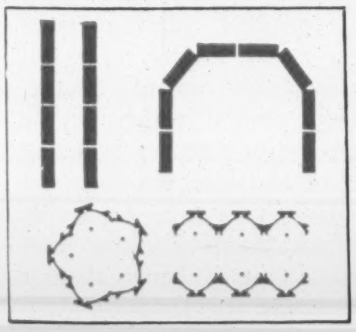
Color Blind Radiation

Longer far-infrared wave lengths are absorbed efficiently by all colors and textures.



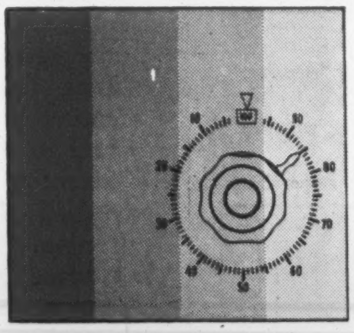
Heat Without Hot or Cold Spots

Chromalox radiant energy goes to work in a uniform pattern to span widest conveyor.



Low-Cost Oven Assembly

Pre-engineered Chromalox units require minimum expense to erect into complete ovens.



Infinitely Variable Heat Output

Heat from 0 to 100% of capacity to fit the exact temperature needs of the work.

plus

- **SHATTERPROOF CONSTRUCTION**—nothing to break or contaminate the work in process.
- **NON-DIMINISHING OUTPUT**—with all-metal Chromalox tubular far-infrared generators.
- **HIGH INTENSITY RADIATION**—with top BTUs per square foot.
- **QUICK HEAT-UP**—with energy transformed instantly into heat on the work.
- **ADDITIONALLY SAFE**-for any work involving volatiles.
- **MINIMUM MAINTENANCE**—Because of metal-sheathed, shock-resistant, long-lasting Chromalox tubular generators.

CHROMALOX *Electric Heat*
FOR MODERN INDUSTRY

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DATA SHEETS

available to you on

APPLICATIONS OF CHROMALOX RADIANT HEAT

ABRASIVES
- ☐ R-111: Drying Silicon Carbide Discs
- ☐ R-122: Drying Abrasive Cloth

ASPHALT
- ☐ L-1055: Melting Korite Sealing Compound
- ☐ R-105: Heating Asphalt to Improve Sealing of Batteries
- ☐ RP-203: Drying Asphalt Tile

AUTOMOTIVE
- ☐ R-126: Drying Tractor Parts
- ☐ R-118: Baking Synthetic Enamel on Gasoline Engines
  Also see; Paint Baking

BATTERY
- ☐ R-105: Heating Asphalt to Improve Sealing of Batteries

BOTTLING (see Glass)

CERAMICS
- ☐ R-115: Drying a Water-Base Glaze on Ceramic Tile
- ☐ R-134: Preheating Dinnerware to Prevent Warping
- ☐ R-137: Drying Pottery

CHEMICALS (see Plastics)

COMFORT HEATING
- ☐ L-1077: Keep Men Warm, Keep Work on Schedule
- ☐ R-114: Comfort Heating for a Foundry Worker

DEGREASING
- ☐ R-116: Vaporizing Oil from Sheet Metal Parts
  Also see: Paint Baking

DRUGS (see Glass)

ELECTRONICS
- ☐ R-109: Drying Cement Base in Television Tubes

FINISHES (see Paint Baking, Degreasing)

FOUNDRY
- ☐ L-1060: Skin Drying of Molds
- ☐ L-1085: Core Drying
- ☐ L-1096: Shell Molding Goes Automatic
- ☐ R-115: Comfort Heating for The Foundry Worker
- ☐ R-130: Drying Precision Plaster Molds
- ☐ R-135: Shell Molding

GLASS
- ☐ C & R-2: Sterlizing & Preheating Bottles
- ☐ R-127: Heating Television Tubes to Bake Interior Graphite Coating

PAINT BAKING
- ☐ L-1064: Drying Lacquered Metal Parts
- ☐ L-1065: Improves Enamel Baking Five Ways
- ☐ L-1066: Bakes Big Parts or Small, Fast or Slow
- ☐ L-1080: Baking Paint on Radiators
- ☐ R-118: Baking Synthetic Enamel on Gasoline Engines
- ☐ R-119: Baking Paint on Metal Awnings
- ☐ R-131: Baking Paint on Meter Parts
- ☐ R-138: Drying Ink and Paint on Toothpaste Tubes

PAPER
- ☐ R-134: Drying Glued Paper Sheeting

PLASTICS
- ☐ L-1086: Drying Vinyl Coating on Imitation Leather
- ☐ L-1091: Post-Forming Formica
- ☐ R-101: Molding Kapok Center for Softballs
- ☐ R-102: Drying Plastic Powders
- ☐ R-104: Preheating Micarta Strips for Punching
- ☐ R-121: Dehydrating Vinyl Sheets
- ☐ R-123: Drying Plastic Laminates
- ☐ R-128: Curing Plastic Coating on Spring Clips
- ☐ R-129: Fusing Vinyl to Chip Board
- ☐ R-132: Embossing Vinyl
- ☐ RP-210: Heating Plexiglas for Vacuum Forming
- ☐ RP-202: Heating Thermoplastic for Vacuum Forming

PRINTING
- ☐ L-1090: Silk Screen Process Drying
- ☐ R-103: Static Removal
- ☐ R-107: Drying Ink on a Miehle Vertical Press
- ☐ R-108: Ink Drying on 8-Unit Web-Fed Offset Press
- ☐ R-110: Eliminating "Offset" on Duplicating Machines
- ☐ R-124: Drying Ink on a Goss Press
- ☐ R-136: Silk Screen Process Drying

REFRIGERATION
- ☐ L-1055: Dehydrating Refrigerator Coils

RESTAURANT
- ☐ Far-Infrared Food Warmer

RUBBER
- ☐ L-1056: Curing Latex Foam Sponge Rubber
- ☐ R-125: Cementing Crepe Rubber to Wooden Soles

TEXTILES
- ☐ L-1068: Fusing Vinyl to Cloth Work Gloves
- ☐ R-112: Dehydrating Braiding Material

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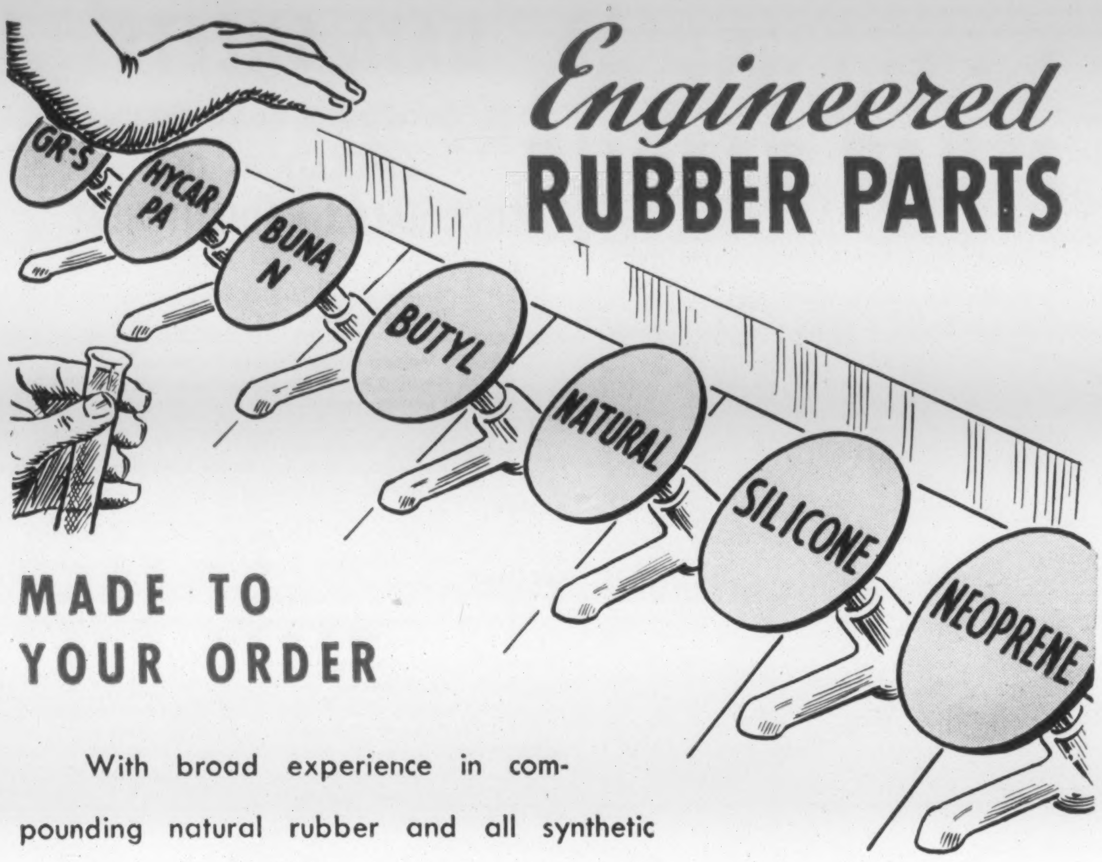

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Send for your copy of the widely used "Acushnet Rubber Handbook", a comprehensive, practical rubber data reference. Please make request on your company letterhead.

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be applied selectively to limited portions of the surface, or to the entire surface. Its color is determined by the alloy used, ranging from amber to black. When used to salvage parts that have been overmachined, the coating can be built up to 0.008 in.

---

mc Metablast

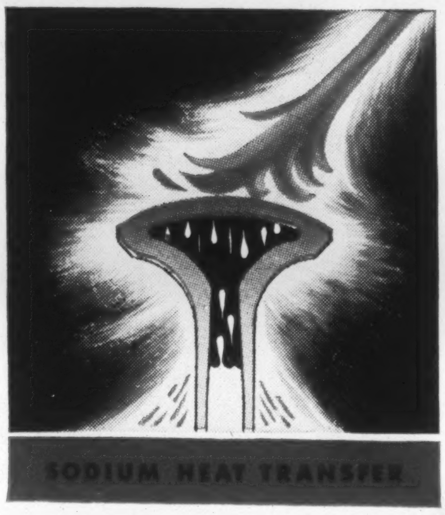
Metal Surfaces Improved with New Blasting Process

With conventional surfacing processes such as sand blasting, shot peening, wire brushing or chemical treatment, difficulty is encountered in predetermining the quality of the surface and in maintaining that quality for each operation. The Metablast process, developed by the *American Metaseal Mfg. Corp.*, W. New York, N. J., is said to allow uniform and controlled surfaces, holding tolerances of 0.0001 in.

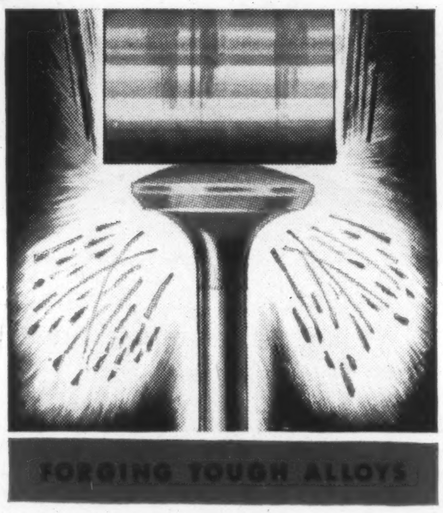
This new process consists of shooting an abrasive, which is suspended in a liquid, in a controlled, high pressure spray against a metal surface. The resulting finish is made up of minute, identical pits, the size of which can be varied in coarseness or fineness by using different grades of Metablast abrasive, and changing the spray's length, force, or direction. The manufacturer claims that a surface of this type is better than a "super-smooth" finish in reducing friction, dissipating heat, and preventing moving metal parts from seizing, sticking, or burning.

Various types of casting molds—die, investment, ceramic, injection, compression—used in mass-producing precision parts, are said to perform better and longer after surfacing with Metablast. The company claims that the tiny pits reduce sticking between mold and casting,

HARD-FACE WELDING



These
facilities
...this
special
know-how



...may hold
ideas
YOU
can use
NOW

Every day the Valve Division is welding thousands of pounds of high-alloy coatings to unusual Thompson-developed alloys to give internal-combustion engine valves added life under super-severe service.

We also insert highly-combustible metallic sodium into hollow valve stems to make engine valves run cooler and last longer.

The Valve Division also knows plenty about forging and finishing extra-tough alloys to precision limits.

If you have out-of-the-ordinary production problems, you'll want to know more about Thompson know-how and facilities. And, if you have ideas about how we can help on new projects, we'd like to talk them over with you.

VALVE DIVISION
Thompson Products, Inc.
DEPARTMENT VR-10 • CLEVELAND 17, OHIO

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Get what you want in **STAINLESS STEELS** right from G.O. Carlson, Inc.

The best way to buy stainless steel—plates, forgings, heads, rings, flanges, bars—is from the "one order" source, G. O. Carlson, Inc. Here at Carlson every item of your order is accurately produced, specifications are matched exactly, delivery promises are met. This control of each detail satisfies customers because it saves them extra paper work, extra stock handling and holds to their production schedules.

Carlson technical and practical experience, coupled with the use of specialized, high production equipment, provide an efficient packaged service. Your order for stainless steel plate and other stainless items is handled quickly, easily and economically.

To cut costs and eliminate confusion—check Carlson *first!* Your inquiry will receive prompt attention.

Stainless Steels Exclusively

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PLATES • FORGINGS • BARS • SHEETS (No. 1 Finish)

THORNDALE, PENNSYLVANIA

District Sales Offices in Principal Cities

For more information, turn to Reader Service Card, Circle No. 334

allowing easier removal of parts and preventing directional lines.

The walls of punching, stamping and pressing dies, if "super-smooth", may cause the metal to grip at the pressure radii, producing thick and thin sections. Metablast's controlled mat surface is said to allow the metal being formed to slide smoothly over the die.

On mating parts such as gears and bearings, Metablasted surfaces serve a twofold function: (1) The tiny pits act as reservoirs for the lubricant and assure an evenly distributed film; and (2) the smaller contact area of the surface reduces the danger of galling. The increased surface area, produced by the pits, is also said to permit better heat dissipation reducing failures of bearings and gears.

The process can also be used as a pre-treatment to prepare metal for painting, bonding, plating, and buffing, the manufacturer says, and is effective in cleaning hard crusts, rust, heat treat scale, old paint, plating or other coatings from metallic parts.

Coatings Provide High Heat and Corrosion Resistance

Two coatings developed by *Nerva-Kote Div., Rubber and Plastics Compound Co., Inc.,* 30 Rockefeller Plaza, New York, offer protection to metallic and non-metallic materials for two different conditions: that of high temperature and chemical corrosion.

Nerva-Kote Tae coatings are room temperature "baked", yet are said to offer the same resistance to alkalies, acids and solvents heretofore only available in high temperature baked coatings. They are said to show excellent impact, abrasion and weathering properties, as well as good cold check qualities. Also they dry fast and may be recoated in 6 to 8 hr. Nerva-Kote Tae coatings are recommended as protective coatings for ducts, machinery, bottle washing and filling equipment, vessels, and tanks. Also, as maintenance replacements for baked coatings where heat can not be applied.

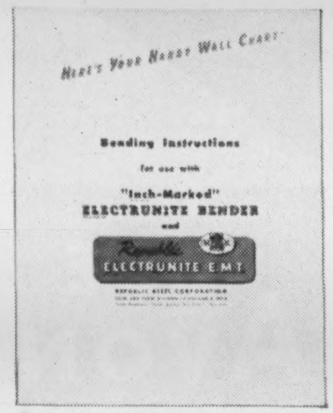
Nerva-Kote Tsi is a silicone resin based coating, which is applied like conventional coatings to surfaces subjected to high thermal conditions. It is said to

Republic
ELECTRUNITE E.M.T.
electrical metallic tubing

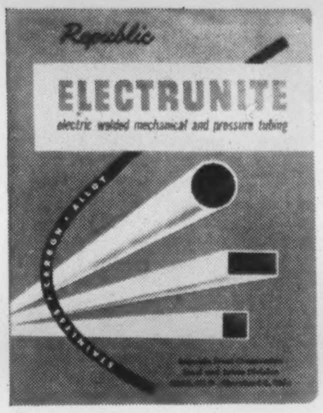
1. Here are all the facts on ELECTRUNITE E.M.T. Includes bending tools and accessories; dimensions and weights of tubing and elbows; facts on "Dekoron-Coated" E.M.T.

Republic
ELECTRUNITE
BOILER,
HEAT EXCHANGER
and CONDENSER TUBES

2. How to specify boiler, heat exchanger and condenser tubes is only one information-packed section of this 20-page booklet. Also includes allowable working pressures.


Here's Your Handy Wall Chart
Bending Instructions
for use with
"Inch-Marked"
ELECTRUNITE BENDER
and
Republic
ELECTRUNITE E.M.T.
REPUBLIC STEEL CORPORATION

3. Handy wall chart with bending instructions for use with "Inch-Marked®" ELECTRUNITE E.M.T. Diagrams are large, easy to read, easy to follow. For quick reference.


Republic
ELECTRUNITE
electric welded mechanical and pressure tubing

4. Product designers interested in mechanical and pressure tubing will find a lot of facts in this brochure. Pictured are many examples of products where costs were trimmed.

Republic
ELECTRUNITE
REPUBLIC STEEL CORPORATION

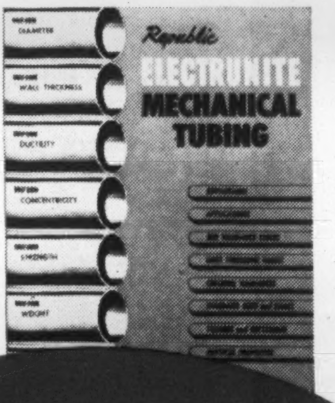
5. Lots of help for design engineers in this 8-page brochure on Mechanical Tubing. Includes advantages; applications; size tolerance tables; gage tolerance tables.

---

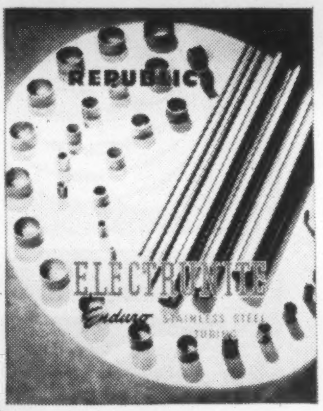
6. Sizes, dimensions and weights of ELECTRUNITE mechanical tubing, pressure tubing and electrical metallic tubing are included in this 8-page booklet. Also fabricating.

SIZE-GAGE
RANGES

7. Most of what you need to know about Stainless Steel Tubing and Pipe can be found in this 28-page booklet. Data on fabricating and finishing, how to lay out drawings.


Republic
ELECTRUNITE
MECHANICAL
TUBING
DIAMETER
WALL THICKNESS
DUCTILITY
CONCENTRICITY
STRENGTH
WEIGHT

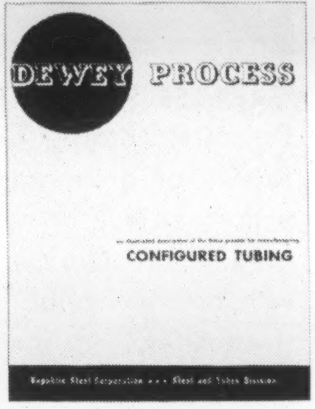
8. Carbon and stainless tubing for the process industries are described in this booklet. Valuable laboratory corrosion data along with properties of Enduro Stainless Steel Tubing.


REPUBLIC
ELECTRUNITE
Enduro STAINLESS STEEL
TUBING

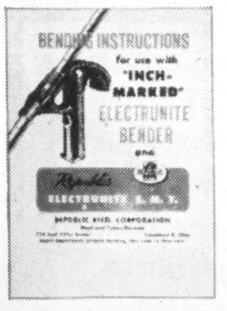
9. This handy chart puts size, gage ranges at your fingertips. Easy to carry in your pocket. Covers mechanical pressure and stainless tubing, along with stainless steel pipe.

Republic ELECTRUNITE
CARBON
AND STAINLESS
TUBING FOR
THE PROCESS
INDUSTRIES
REPUBLIC STEEL CORPORATION • STEEL AND TUBES DIVISION

10. Product designers balked by the high cost of unusual tubular shapes will be interested in this booklet on the Dewey Process for configured tubing. Process is shown in pictures.


DEWEY PROCESS
CONFIGURED TUBING
Republic Steel Corporation • • • Steel and Tubes Division

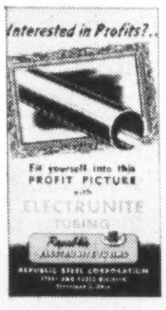
Here's Your FREE LIBRARY On Mechanical Tubing, Pressure Tubing, Stainless Steel Tubing And Pipe, And Electrical Raceways


BENDING INSTRUCTIONS
for use with
"INCH-MARKED"
ELECTRUNITE
BENDER
and
Republic
ELECTRUNITE E.M.T.
REPUBLIC STEEL CORPORATION

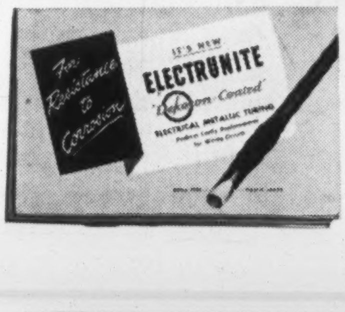
11. When journeymen want instructions on how to bend ELECTRUNITE E.M.T. all you do is hand them this booklet of bending instructions. Pocket size.

BENDING INSTRUCTIONS
for
Republic 1¼" E.M.T. BENDER
Republic
ELECTRUNITE E.M.T.

12. Pictures and captions tell the story of how to use the Republic ELECTRUNITE E.M.T. 1¼" bender.


Interested in Profits?..
Fit yourself into this
PROFIT PICTURE
with
ELECTRUNITE
TUBING
Republic

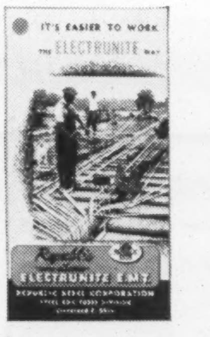
13. Some ideas on where to use tubing profitably are contained in this handy reference folder. Also contains size ranges.


For Resistance to Corrosion
IT'S NEW
ELECTRUNITE
Dekoron-Coated
ELECTRICAL METALLIC TUBING

14. Advantages of using "Dekoron-Coated" ELECTRUNITE E.M.T. are explained in this compact folder. Shows how easy it is to install this polyethylene coated raceway in corrosive atmospheres.

...en life's too short
SWITCH TO
ELECTRUNITE
Stainless Steel Tubing
and Pipe
REPUBLIC STEEL CORPORATION

15. Eight analyses of stainless steel tubing, pipe and general uses.


IT'S EASIER TO WORK
THE ELECTRUNITE WAY
Republic
ELECTRUNITE E.M.T.
REPUBLIC STEEL CORPORATION

16. Outstanding features of ELECTRUNITE E.M.T. are briefly described.

For Resistance
to Corrosion
ELECTRUNITE
Dekoron-Coated

17. Complete engineering data on "Dekoron-Coated®" ELECTRUNITE E.M.T.

Short Cuts
TO LONG SAVINGS
HERE
HERE
HERE
ELECTRUNITE
Republic
REPUBLIC STEEL CORPORATION

18. Advantage using ELECTRUNITE boiler, heat exchanger or condenser tubes.

REPUBLIC
STEEL
®

Republic
ELECTRUNITE TUBING

CLIP COUPON AND MAIL TO:

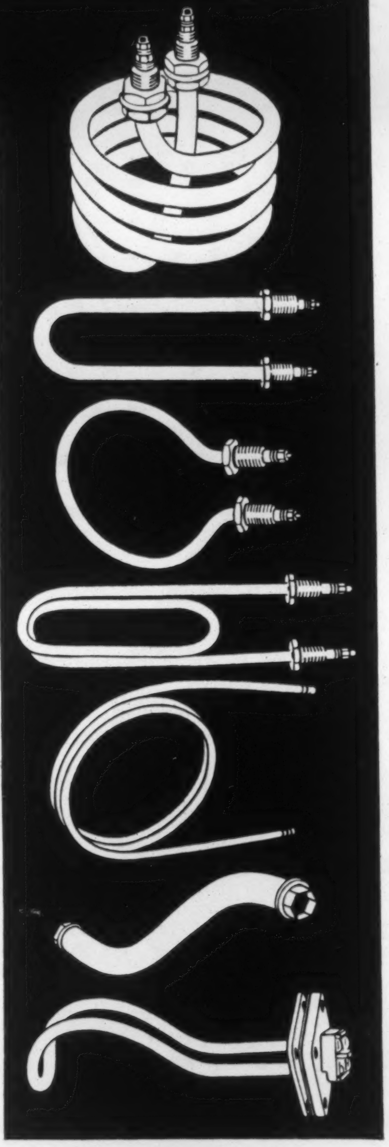
REPUBLIC STEEL CORPORATION, ***Steel and Tubes Division***
East 131st Street, Cleveland 8, Ohio

Name . . . . *Position* . . . .
Company . . . .
Address . . . .
City . . . . *Zone* . . . *State* . . . .
Please send me the following literature (circle numbers desired)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

For more information, turn to Reader Service Card, Circle No. 478

if you use tubing...

USE AVON Fusionweld for these *plus* advantages



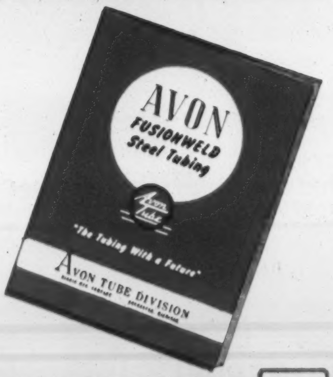
GREATER STRENGTH is offered by Avon's new Fusionweld process because of the complete uniformity of grain structure found throughout the entire tube wall, including the highly critical welded area. This feature eliminates the need for bonding with another metal, also eliminates the internal stresses resulting from variables in expansion coefficients where rapid temperature changes are involved. Fusionweld thin-wall steel tubing now can be employed as a satisfactory, low cost substitute in most electro-thermal tubing applications with absolute confidence in the end results.

ADDED DUCTILITY of Avon Fusionweld thin-wall steel tubing provides new ease of forming even the most complicated shapes due to our new controlled method of annealing in special atmospheric furnaces. This important characteristic insures lower scrap loss in fabrication and superior performance in most electrical sheathing applications.

SMOOTHER O.D. tor fine finish brass or chrome plating is offered in all Avon Fusionweld tubing for electrical fixture manufacturers.

MORE ECONOMICAL—Avon Fusionweld guarantees a very definite price advantage coupled with greatly broadened usefulness and new savings which now can be affected in fabricating operations—with far greater freedom from scrap loss.

3/16" O.D. to 5/8" O.D. Plain or Terne Coated.
We can fabricate tubing to your requirements.

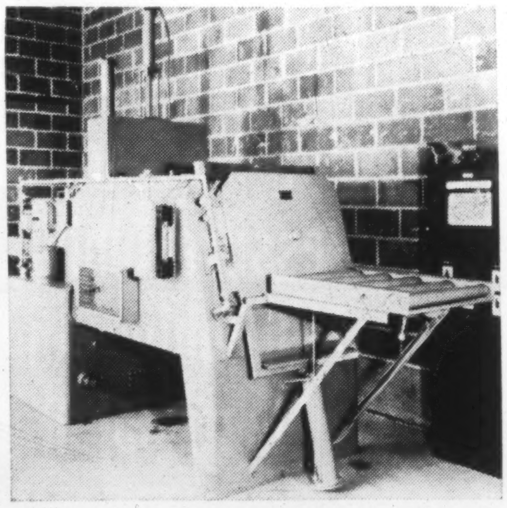


AVON TUBE DIVISION
HIGBIE MANUFACTURING CO.
ROCHESTER MICHIGAN

For more information, turn to Reader Service Card, Circle No. 464

New Materials and Equipment

have a heat service range up to and including 1,500 F, and good flexibility, adhesion and outdoor weatherability. The pigments used in the coating are high heat resistant types of leafing aluminum or graphite. Nerva-Kote Tsi has been experimentally applied to panels and subjected to continuous temperatures of 1,000 F for over six months without any failure, the company reports. Other groups of coated panels have been alternately subjected to cooling and heating cycles of from 60 to 1,000 F without checking, alligatoring or failure. This coating is recommended for service on smoke stacks, boilers, distillation towers, hot piping, exhaust pipes, heat exchangers, radiators, chimneys, steam lines and other hot process equipment.

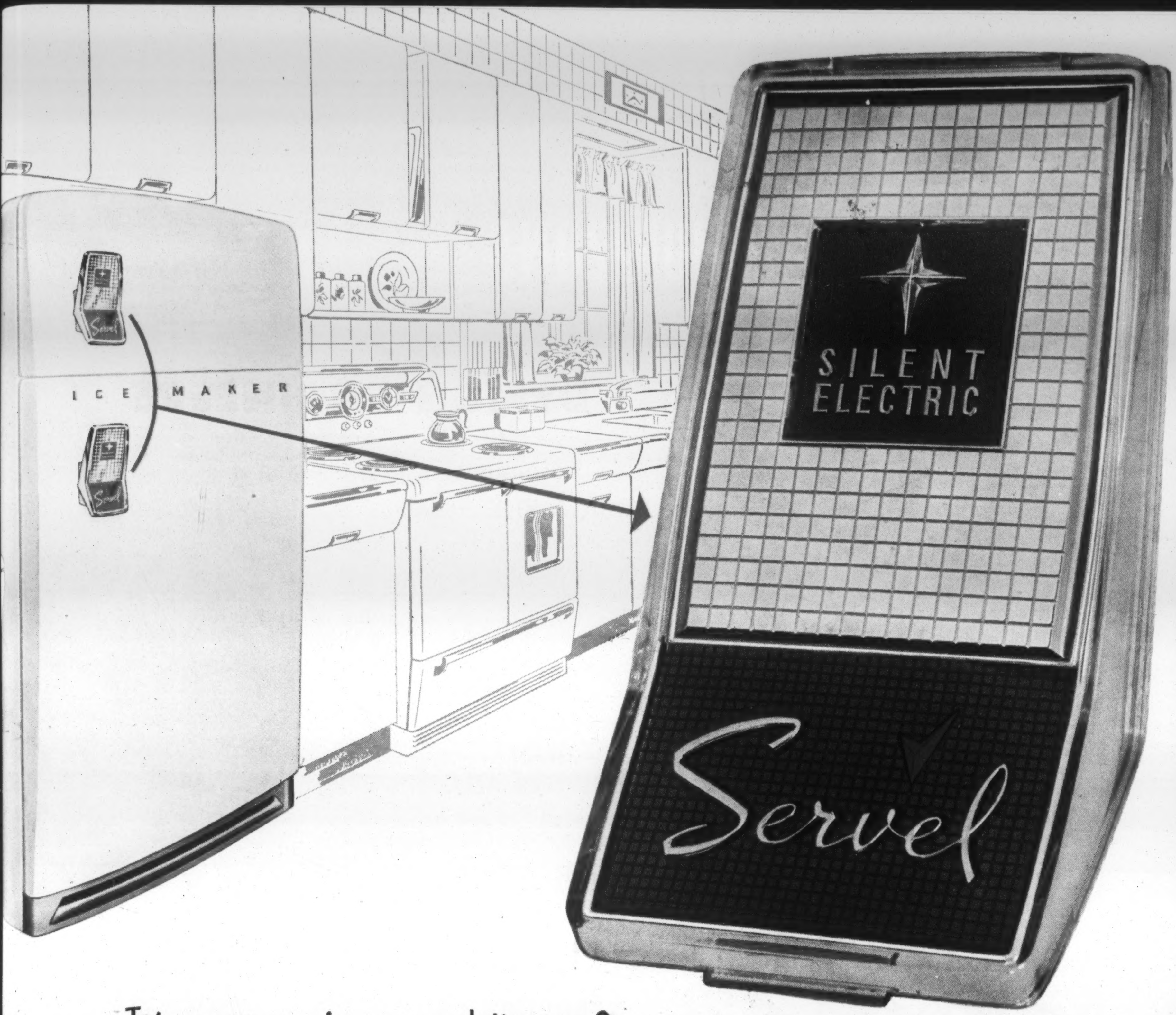


Metal Treating Unit Provides Automatic Draw-Quenching

A controlled atmosphere draw-quench unit, designed for both bright, scale-free tempering and controlled oxidation tempering from 400 to 1400 F, has been marketed by *Ipsen Industries Inc.*, Rockford, Ill. The D-Q-300 furnace is a fully automatic sealed unit with the heating chamber separated from the combination cooling chamber and quench tank by a sealed inside door. The parts being treated do not contact air at any time during the tempering, and work that has been previously bright hardened remains clean and scale-free, eliminating blasting or pickling operations. The

(Continued on page 188)

For more information, Circle No. 395 ➤



. . . It's a one-piece molding of
PLEXIGLAS

New Servel "Automatic Ice-Maker" gas and electric refrigerators feature handles that can be operated by wrist or elbow. Colorful handle-facings, 7½" x 4" x 1½", are molded of PLEXIGLAS V-100.

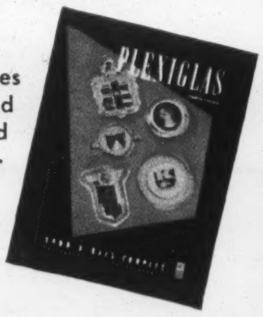
The handsome face of this refrigerator handle is not an assembly of separate parts. The raised edges, the sides, lettering, markings, and background areas are all part of the same single molding—of PLEXIGLAS acrylic plastic.

The molding is transparent—metallized and spray painted on the rear surface to produce the brilliant chrome bezel effect, the mirrored and richly colored backgrounds, the gleaming letters and decorations.

In addition to eye-catching appearance, the part has excellent serviceability. Because it is molded of PLEXIGLAS, its crystal clarity does not change with age . . . and it has the strength and stability to withstand hard knocks, sudden shocks, moisture, and constant handling.

The chances are that parts molded of PLEXIGLAS can add durable sales appeal to the product *you* are designing or manufacturing, too. We will be glad to tell you how this acrylic plastic, so widely used in many fields, can meet your specific requirements.

This booklet, "PLEXIGLAS Molding Powders", describes the properties and advantages of PLEXIGLAS and shows how it is being used for molded parts and extruded sections in outdoor and indoor applications. Write to the Plastics Department for it today. You will receive it promptly.



CHEMICALS FOR INDUSTRY

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

Representatives in principal foreign countries

PLEXIGLAS *molding powders are listed in Sweet's Product Design File, Section 1c/Ro.*
PLEXIGLAS *is a trade-mark, Reg. U. S. Pat. Off. and in principal foreign countries*
Canadian Distributor: *Crystal Glass & Plastics, Ltd., 130 Queen's Quay at Jarvis Street, Toronto, Ontario, Canada*

*NEW HORIZONS

. . . for DESIGN ENGINEERS

*To the engineer who is seeking
more DESIGN FREEDOM,
Arwood Precision Castings offer
a flexibility of design
which opens new avenues of approach.

IMPROVED FUNCTION OF PRODUCT

LONGER LIFE

BETTER SALABILITY

FREES PRODUCTION EQUIPMENT

REDUCTION OF COST

WIDER CHOICE OF ALLOYS

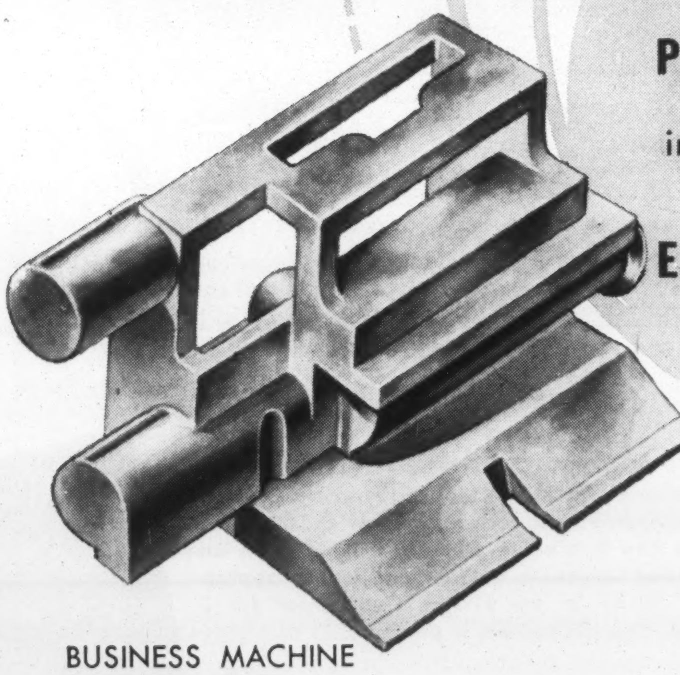
Provides for use of more advantageous metals

PRODUCTION OF PECULIAR, COMPLEX SHAPES

can be accomplished in one cast without assembling

REDUCTION OR ELIMINATION OF MACHINING

Design is free from machining limitations



BUSINESS MACHINE PUNCH GUIDE

This part was expensively machined originally from bar stock and subsequently designed as a sand casting.

ARWOOD ENGINEERS REDESIGNED THIS PART as an investment casting, resulting in 25% reduction in machining time and savings of nearly 50% in metal.

Slippage was eliminated and positive contact assured by changing to a more advantageous alloy, creating improved efficiency in performance of the part.

Additional savings also were obtained by reduction of reject parts.

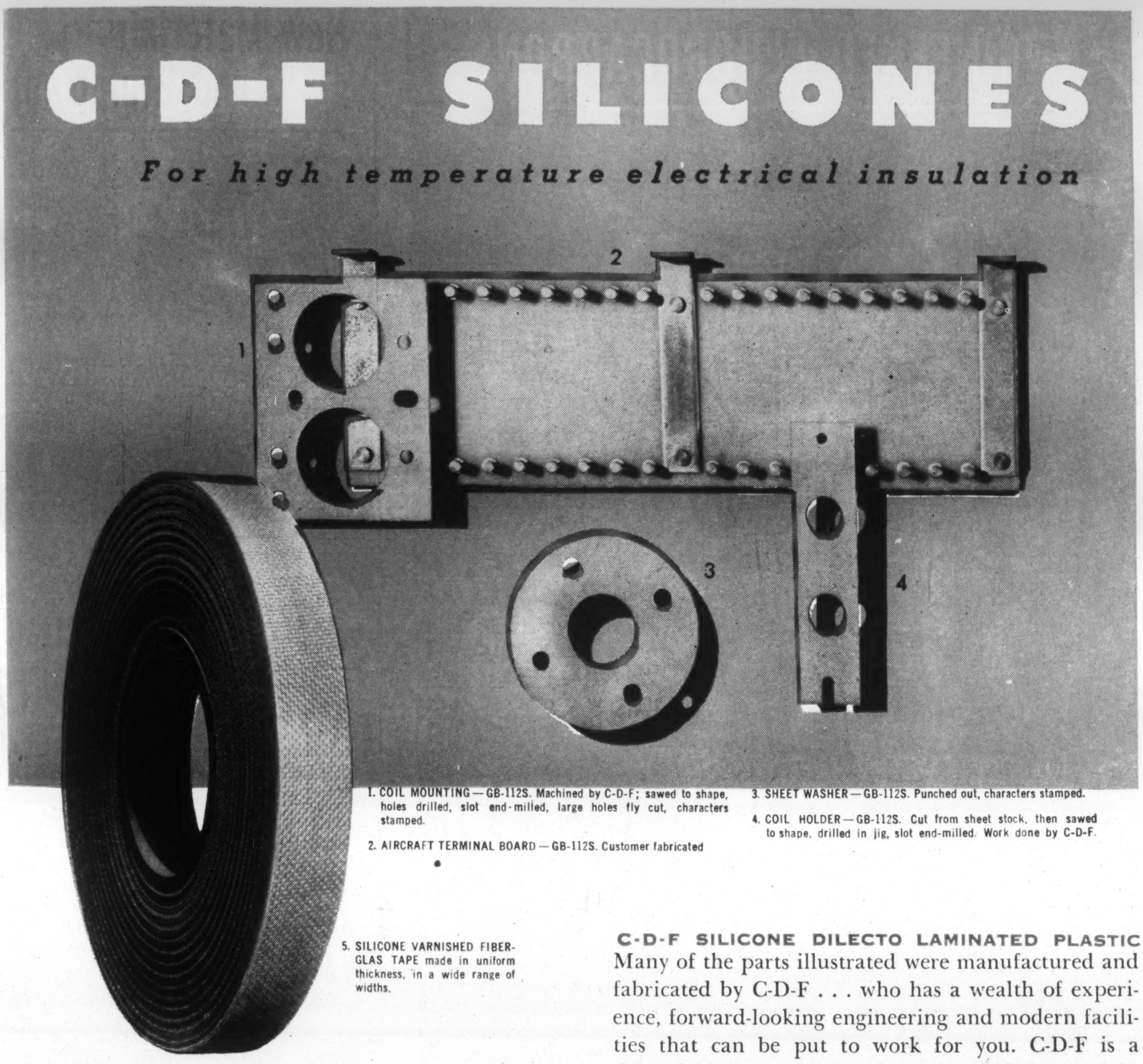
Visit us at the National Metal Exposition
Cleveland Public Auditorium
Cleveland, Ohio. Booth #1428.

ARWOOD
PRECISION CASTING Corp.
74 WASHINGTON STREET B'KLYN 1, N. Y.
Plants: Brooklyn, N. Y. • Groton, Conn. • Tilton, N. H.

For more information, turn to Reader Service Card, Circle No. 500

C-D-F SILICONES

For high temperature electrical insulation



1. COIL MOUNTING—GB-112S. Machined by C-D-F; sawed to shape, holes drilled, slot end-milled, large holes fly cut, characters stamped.
2. AIRCRAFT TERMINAL BOARD—GB-112S. Customer fabricated
3. SHEET WASHER—GB-112S. Punched out, characters stamped.
4. COIL HOLDER—GB-112S. Cut from sheet stock, then sawed to shape, drilled in jig, slot end-milled. Work done by C-D-F.
5. SILICONE VARNISHED FIBERGLAS TAPE made in uniform thickness, in a wide range of widths.

C-D-F SILICONE TAPES are recommended for Class H insulation. It's been proved that silicone insulation has 10 times longer life than Class B insulation, even at the temperature limits of Class H. There are two types of C-D-F Silicone Tapes and Sheets: (1) Silicone varnished fiberglas; (2) Silicone rubber fiberglas. Each has the following properties:

- High temperature resistance
- High dielectric strength
- Low dielectric loss
- Resistance to moisture
- High tensile strength
- Flexibility

Both grades meet A.I.E.E. Standard for Class H insulation. They resist mild alkalis, non-oxidizing acids, mineral oils, oxygenated solvents. Silicone rubber fiberglas is recommended for many applications requiring a flexible abrasion-resistant material with good thermal conductivity. C-D-F Silicone tapes and sheets are available in a wide range of sizes in continuous rolls. For complete details, write for Technical Bulletin #47.

C-D-F SILICONE DILECTO LAMINATED PLASTIC
Many of the parts illustrated were manufactured and fabricated by C-D-F . . . who has a wealth of experience, forward-looking engineering and modern facilities that can be put to work for you. C-D-F is a dependable source of supply for insulating materials, and is noted for its fair pricing, for producing high quality products on schedule. Why not call in a C-D-F sales engineer on your problem. Or, write for Technical Bulletins:

#25—complete data on GB-261S, a fiberglas silicone laminate made of a staple filament woven fiberglas cloth and silicone resin in sheet form; #37—covers glass base silicone metal clad laminates; #42—postforming grade of glass base silicone in sheet form; #23—GB-112S, fine weave continuous filament woven fiberglas with silicone resin, sheets, tubes, rods, molded shapes.

THE NAME TO REMEMBER . . . CDF SILICONE TAPES, SHEETS, TUBES, RODS

Continental-Diamond Fibre Company
NEWARK 25, DELAWARE

For more information, turn to Reader Service Card, Circle No. 541

ENGINEERED FLUOROCARBONS

SILICATES
ASBESTOS
MICA
QUARTZ
GRAPHITE
CALCIUM
TEFLON PLUS
CERAMICS
GLASS
METALS
ZERO-PLAST
CARBONS
ALNICO

Offer Engineers a Whole New Family of Materials

Starting with TEFLON*, United States Gasket Company engineers have developed a series of "Filled" Fluorocarbon materials, greatly broadening the scope of usefulness of this wonder-plastic. For example, United States Gasket Company "Application Engineering" has already helped solve such material problems as long-wearing chemical resistant bearings and pump impellers; valve and pump packings, expansion joints and chambers, gaskets; the metal plating of Teflon; the hermetic sealing of electronic components; soldering and cementing to Teflon; etc., etc.

If you have a special materials problem, that one of these Teflon "alloys" might solve, tell us about it. Our engineering department will work with yours to determine the Chemelec Mixture best suited to your requirements.

UNITED STATES GASKET COMPANY

FLUOROCARBON PRODUCTS DIVISION
FABRICATORS OF "TEFLON" "KEL-F" AND OTHER FLUOROCARBON PLASTICS
CAMDEN 1, NEW JERSEY

UGS

*duPont's trademark for its tetrafluoroethylene resin.

For more information, turn to Reader Service Card, Circle No. 325

New Materials and Equipment

controlled atmosphere also makes possible holding oxidation or blue tempering within strictly controllable limits.

The combining of the draw and quench in a single unit makes possible the transferring of heated work into quench or cooling zone without furnace cooling or work handling delays. After completion of the heating cycle, the intermediate door opens automatically and chain-driven rods move into the heat zone, contact the load with cam actuated arms, and transfer the trays to the quench rack. The intermediate door reseals automatically, allowing another work tray to be loaded immediately into the heat zone.

For controlled oxidation or blueing, a predetermined quantity of water is admitted automatically into the furnace during part of the heating cycle. The water vaporizes, forming the oxidizing atmosphere. The amount of water, time of oxidation and temperature are controlled by presettings on the Ipsen control panels to obtain the thickness and desired chemical makeup of the oxide.

Electric heating elements are located in the hearth below the load, and heating of the work is primarily by forced convection. An alloy fan circulates atmospheres through the load. Temperatures of the sealed quench and cooling zone are controlled by immersion heating elements and water jackets around the cooling chamber.

Although designed particularly for bright tempering and controlled oxidation of steel, the D-Q-300 can be used for straight heat treatment of steels below the critical point, for annealing of copper and brass, solution heat treatment of aluminum, and the precipitation or solution heat treatment of beryllium copper, the manufacturer says.

The Ipsen Industries Inc., has also marketed an Automatic Dew Point Controller which regulates atmosphere dew point in controlled atmosphere metal treating furnaces. The unit, which operates electronically, is adjustable to meet any required dew point within the capacity of the particular furnace to which it is attached. By use of a cooling element, the Controller condenses water on a measuring device. This condensation temperature is measured electrically, then indicated, recorded on a continuous graph located on the face of the instrument, and controlled. Ammonia in the furnace atmosphere does not harm or affect the accuracy of the measurement.

As there is a definite relationship between the dew point of the atmosphere and its carbon potential, automatic control of the furnace dew point will result in bright, scale-free results in a

For more information, Circle No. 359 ➤

Dog leash and collar and handle grips by Hungerford Plastics Corp., Rockaway, N. J.

Maid of Marvinol... smart and practical!

Easy to see why! These Marvinol® vinyl products—injection molded by Hungerford, a pioneer and leader in the field of injection molded vinyls—provide *new eye appeal, serviceability,* and *economy.*

Made of new Marvinol VR-21, they're...

- *brilliantly, lastingly colored*
- *completely non-staining to hands and clothing*
- *impervious to water, perspiration, oil, gasoline, most chemicals*
- *flexible at below zero temperatures*
- *sun and weather resistant*
- *resistant to chipping, cracking, and abrasion*
- *always pleasant to the touch*

And Marvinol VR-21 makes them economical to produce. A straight polyvinyl chloride resin, VR-21 processes as easily as a copolymer resin. It gives dry, fluffy premixes without the use of heat, and has excellent tolerance for plasticizers. In fact, VR-21 is so easy to process, it makes these injection molded items competitive.

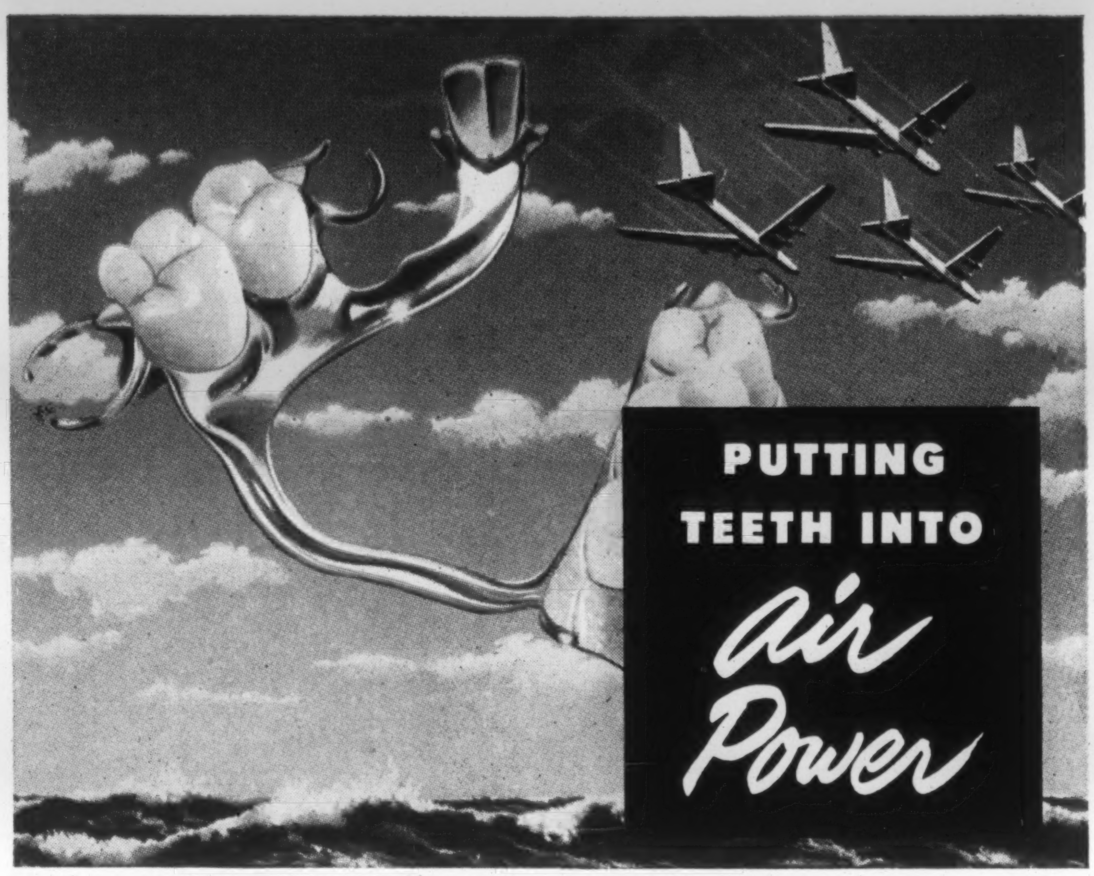
Whether you calender, extrude, mold, or laminate, "Made of Marvinol" might well be the customer-pleasing, profit-making advantage your product needs. Why not discuss it with a Naugatuck technical sales representative?

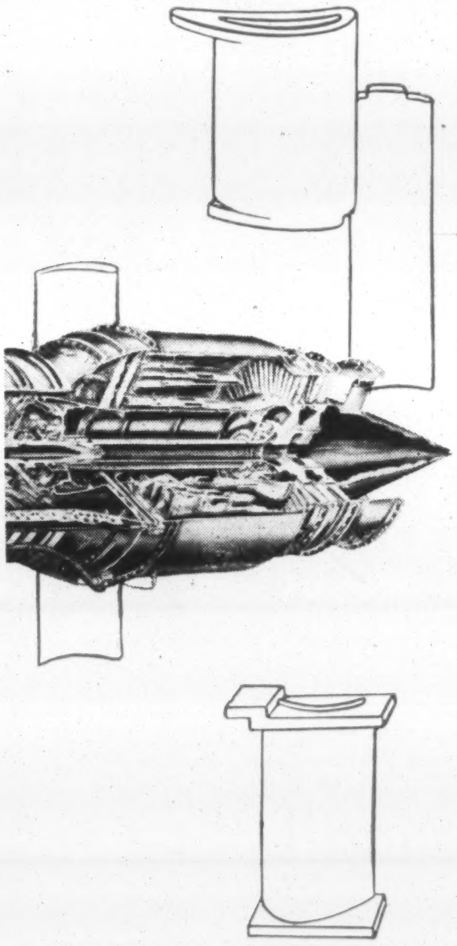
For more about this partner to Naugatuck's VIBRIN® polyesters and KRALASTIC® rubber-resin blends, write on your letterhead to the address below.

Naugatuck Chemical

Division of **UNITED STATES RUBBER COMPANY** • 110 Elm Street, Naugatuck, Conn.

BRANCHES: Akron • Boston • Charlotte • Chicago • Los Angeles • Memphis
New York • Philadelphia **IN CANADA:** Naugatuck Chemicals, Elmira, Ontario





Oddly enough, the metal fabricating process first used to produce cobalt-chrome dentures helped put the "bite" into World War II bombers. The tiny power blades in the turbo-superchargers of high-flying B-17's and B-29's that provided extra speed and longer range were precision cast from high-temperature alloys by the unique Microcast Process.

Originated in 1929 by Austenal Laboratories, Inc., to cast non-machineable alloys, the Microcast Process today is used to produce parts and components from a wide range of ferrous and non-ferrous metals.

The Microcast Process offers exceptional opportunities in the mass production of parts and components. Product improvement through the use of better alloys, economies through the elimination of expensive machining operations, and greater freedom of part design are only a few of its advantages. Investigate Microcast today . . . it may well be the means of a better product at lower cost for you.

Write for literature—new Microcast color movie also available

MICROCAST PRECISION CASTINGS PROCESS

microcast®

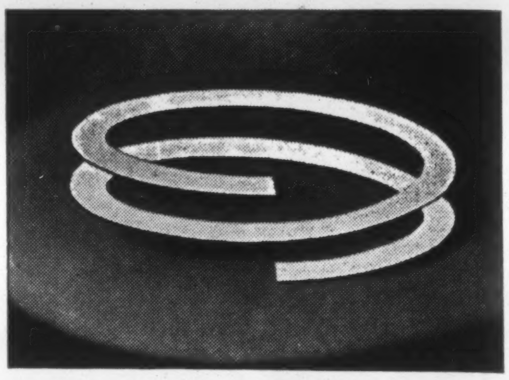
MICROCAST DIVISION
AUSTENAL LABORATORIES, INC.

224 East 39th St., New York 16, N. Y.
7001 South Chicago Ave., Chicago 37, Ill.

For more information, turn to Reader Service Card, Circle No. 351

New Materials and Equipment

variety of heat treating operations including carburizing, carbonitriding, carbon restoration, annealing, normalizing, and hardening.



Teflon Prevents "O"-ring Extrusion

Back-up rings, spirally machined from Du Pont's Teflon have been designed by the *Garlock Packing Co.*, Palmyra, N. Y., to prevent extrusion of "O"-rings. The Teflon rings are said to have a high impact strength at temperatures from —100 to +500 F; are non-corrosive, non-adhering, non-fraying, inert to most chemicals and self-lubricating.

They are available for all "O"-ring sizes to AN drawings 6227 and 6230.

Portable Temperature Test Chamber

The Statham Model TC-1 Temperature Test Chamber is a completely self-contained temperature-controlled chamber for the performance of ambient temperature variation tests from —65 to 275 F. It was designed by *Statham Development Corp.*, 12411 W. Olympic Blvd., Los Angeles, for the convenience of individual research workers and the small laboratory unit as well as for production line tests of various types of small products.

The chamber is fully insulated and consists of a completely sealed inner chamber and outer cabinet of welded dural construction. Cooling is carried out by carbon dioxide ice, and heating is accomplished by a strip heater. Forced circulation of air in uniform mixture takes

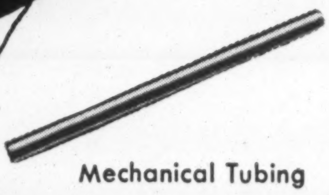
LOOKING FOR CORROSION RESISTANT MATERIALS?

try Bishop . . . specialists in materials for corrosion resistance

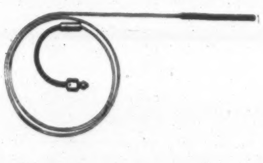
- SIMPLIFY MAINTENANCE
- CUT UPKEEP COSTS WITH . . .

Stainless Steel Tubing

.008″ to 1″ OD (Also Nickel, Monel and K-Monel)

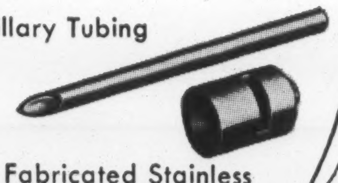


Mechanical Tubing



Capillary Tubing

Hypodermic Tubing

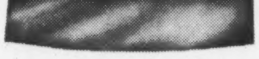


Fabricated Stainless Steel Tubular Parts

Platinum

(and Platinum Group Alloys)

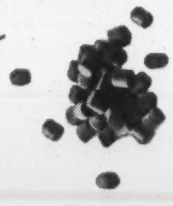
Laboratory Ware



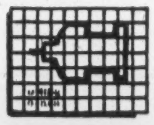
Sheet

Gauze

Wire and Tubing



Catalysts



Fabricated Parts

SERVING SCIENCE & INDUSTRY
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J. BISHOP & CO. Platinum Works

Malvern, Pennsylvania

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What do you mean —

Controlled Atmospheres

Atmospheric control is not new. It was first achieved by wise old Mother Nature who saw in this ability untold possibilities.

The modern chemist, bottler, manufacturer, metallurgist, or food packer knows of the many advantages of controlling the atmosphere. He uses such control to prevent explosions or plugged paint lines, to get fizz into soft drinks and to make dry ice, to achieve perfect welding and heat treating of metals, to keep foods fresh, and in hundreds of other ways.

Modern gas generation equipment has made it possible for even the small user to generate his own special gas—nitrogen, carbon dioxide, annealing, inert, etc.—at tremendous savings. So, if your business requires atmospheric control or special gases you'd be wise to get the last word in this equipment. It's available simply by dropping a card to Gas Atmospheres, Inc., outlining your particular problem.

Gas Atmospheres, Inc., builds a complete line of controlled atmosphere equipment including Inert, Annealing, Reducing, Nitrogen and Carbon Dioxide Generators; Refrigerant and Dessicant Dryers, and Gas Purification equipment.

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A LEE WILSON ENTERPRISE

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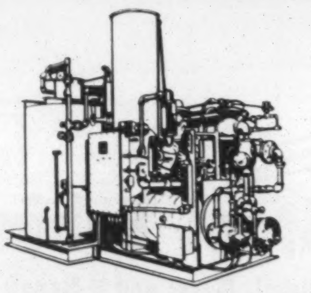
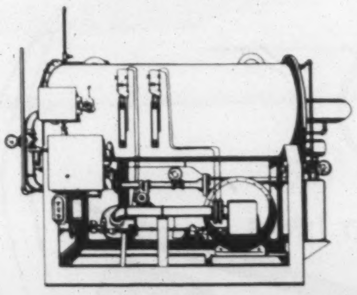
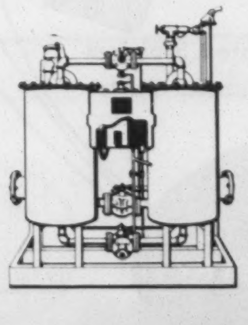
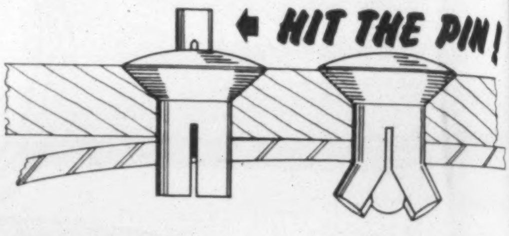






New Materials and Equipment

place at all times. Thermostate control and balancing heat against dry ice evaporation, permit the holding of any temperature within the range of the unit to a tolerance of ±3 F. The Model TC-1 accepts a load volume of 600 cu in., and comes ready for operation requiring no external accessories.



Oval Head Countersunk Blind Rivets

A new product in the line of blind fasteners has been marketed by the *Southco Div., South Chester Corp.*, Lester, Pa. The Southco Drive Rivet is installed with an ordinary hammer which drives the pin, expanding four prongs to form a blind head against the interior surface of the work. The oval-head countersunk rivet is designed for installations where a finished head appearance is of extreme importance in joining wood or metal.

The manufacturer states that the product offers the three-fold advantage of allowing application from one side, permitting speedy assembly, and exerting a high degree of "pull-up" in bringing parts together.

Drive Rivets are available in dia of 1/8, 3/16, and 1/4 in., grip lengths varying from 3/32 to 5/8 in.

Plastic Seal for Pressure Castings

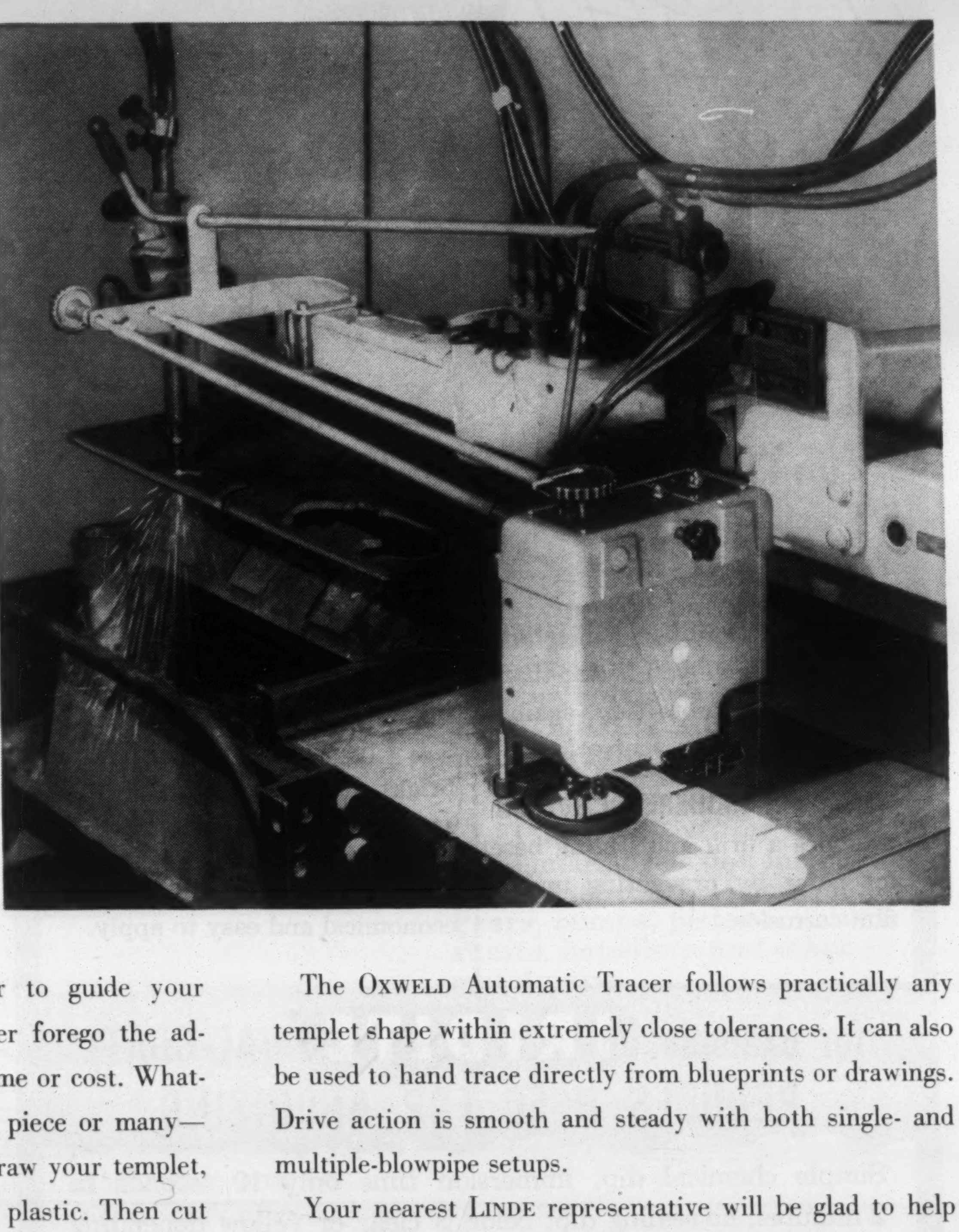
A new plastic sealant for impregnating pressure castings has been marketed by *Tincher Products Co.*, Sycamore, Ill. Imprex plastic seal is said to have penetration properties which enable it to saturate all porous areas of the metal. Upon hardening, there is no loss from evapora-

SIMPLIFY Your Shape-Cutting Jobs with the . . .

OXWELD Automatic Tracer

Trade-Mark

- Positive templet contact . . . electronic steering control . . . maximum tracing accuracy
- Templets are easy to make, low-cost
- No kerf allowance required in templet
- Intricate shapes easily reproduced
- Dynamic braking prevents overruns
- Local or remote controls . . . simple to operate



With an OXWELD Automatic Tracer to guide your oxygen-cutting machine, you need never forego the advantages of templet tracing because of time or cost. Whatever the shape—whether you need one piece or many—templet requirements are simple. Just draw your templet, full size, on a thin sheet of inexpensive plastic. Then cut it out with scissors or knife. It's that quick and easy. There's no tedious forming. To compensate for kerf width, just set a handy dial on the Tracer.

The OXWELD Automatic Tracer follows practically any templet shape within extremely close tolerances. It can also be used to hand trace directly from blueprints or drawings. Drive action is smooth and steady with both single- and multiple-blowpipe setups.

Your nearest LINDE representative will be glad to help you plan an OXWELD Automatic Tracer installation to fit either your present shape-cutting machine or one of the available OXWELD Shape-Cutting Machines.

WRITE TODAY FOR FREE BOOKLET F-8086

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LINDE AIR PRODUCTS COMPANY
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30 East 42nd Street UCC New York 17, N. Y.
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high corrosion resistance
paint base
bright finishes
final finishes

SPECS FOR NON-FERROUS FINISHING GOT YOU DOWN?

FIND OUT ABOUT IRIDITE TODAY for finishing ZINC, CADMIUM, ALUMINUM, CUPROUS METALS

WANT CORROSION RESISTANCE? Iridite will give you better-than-specification protection against corrosion.

WANT PAINT ADHERENCE? Iridite provides a firm and lasting base for paint by preventing under-film corrosion.

WANT EYE-APPEAL? Iridite can give you a variety of finishes, depending upon the metal being finished . . . from clear and sparkling bright or military olive drab, to attractive dyed colors.

BEST OF ALL, any Iridite finish is economical and easy to apply.

for example: IRIDITE® (AL-COAT) REDUCES NEED FOR ANODIZING

Simple chemical dip; immersion time only 10 seconds to 2 minutes; no sealing dip; color is clear or yellow depending upon your requirements; salt spray resistance equivalent to 20 to 30 minutes of anodizing, eliminates need for costly racks and electrical power.

WANT TO KNOW MORE? Write for literature and send production samples for free test processing. See "Plating Supplies" in your classified telephone directory or write direct.

Iridite is approved under government specifications.

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Manufacturers of Iridite Finishes
for Corrosion Protection and Paint Systems on Non-Ferrous Metals; ARP Plating Brighteners.
West Coast Licensee: L. H. BUTCHER COMPANY

For more information, turn to Reader Service Card, Circle No. 301

tion and 15 to 50% less shrinkage than other plastic seals. This low shrinkage factor aids in ensuring a good bond between the casting and the plastic as it hardens.

An important advantage, according to the manufacturer, is that the Imprex plastic seal can be washed off with water, eliminating the need for volatile and expensive solvents. The material qualifies for government contracts calling for impregnation and can be applied with standard methods and equipment.

Improved Nondestructive Materials Tester

A new model Ultrasonic Metroscope particularly useful where wall thickness measurements or tests must be made from one side of the material only, has been announced by the *J. W. Dice Co.*, Englewood, N. J., sole distributors for the instrument. This Model MS-101 is said to be greatly improved in signal-to-noise ratio, picture clarity and line voltage correction over the manufacturer's original model.

Some of the applications which the maker cites for the device are testing and measuring in the construction of propeller blades, tanks, pressure vessels and cylinders, ship plate, pipes, bomb casings or any formed or drawn shape. The instrument is also useful in spotting internal laminar defects in sheet materials and

Electrolizing

ADDS 200% TO 800% LONGER LIFE

to metal parts affected by wear, abrasion or corrosion

Is your problem wear, abrasion or corrosion of metal parts? Then you will be interested in the facts and figures from major companies which conclusively prove that ELECTROLIZING increases part life 200 to 800%!

These manufacturers specify ELECTROLIZING for hydraulic equipment, precision instrument parts, fuel control components, gears, pumps, pistons, valves, shafts, impellers and other metal parts.

HERE'S A CASE IN POINT:

A manufacturer of fuel metering equipment submitted test parts to ELECTROLIZING in an effort to solve the related problems of wear and fretting corrosion. The following is a condensed report of their laboratory observations.*

"NO signs of CORROSION after 72-hour salt spray test per A.S.T.M. specification.

"NO signs of WEAR after 400-hour endurance test.

"NO signs of FRETTING CORROSION after 50-hour vibration test."

Repetitive tests resulted in ELECTROLIZING being specified on all bushings and shafts to prevent malfunctioning of the assembly.

Whether your problem is wear, abrasion or corrosion ELECTROLIZING can provide the solution. Our staff engineers are available for consultation without obligation.

Write for new booklet describing *ELECTROLIZING* and its advantages. **Name on request*

THE Electrolizing CORPORATION

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THE ELECTROLIZING CORPORATION
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Chicago Heights, Illinois

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Company ....

Address ....

City .... *State* ....

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Here are the advantages of BARRETT® BRAND ANHYDROUS AMMONIA for Metal Treating

It is **one of the most economical sources** of hydrogen and nitrogen for metallurgical uses.

You get **4500 cubic feet of mixed gases** when one 100-pound cylinder of Barrett® Brand Anhydrous Ammonia is dissociated at normal temperature and pressure. Or approximately 3375 cubic feet of hydrogen and 1125 cubic feet of nitrogen.

Properly working cylinder valves insure trouble-free use when cylinders reach you.

Fast delivery service of ammonia in 150, 100 and 50-pound cylinders. Coast-to-coast stock points and an adequate supply of cylinders make this possible.

Free technical help from men specially trained in the use of anhydrous ammonia for metal treating.

●

All of this adds up to greater savings, better service and better performance for you. Write for your free copy of a new booklet, "Guide for the Use of BARRETT® Brand Anhydrous Ammonia in Cylinders."

Always specify Barrett® Brand Anhydrous Ammonia—the brand with the bright green cylinder caps.

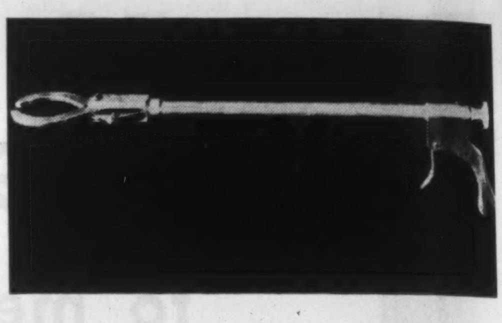
NITROGEN DIVISION ALLIED CHEMICAL

Nitrogen Division
ALLIED CHEMICAL & DYE CORPORATION
40 RECTOR STREET, NEW YORK 6, N. Y.

For more information, turn to Reader Service Card, Circle No. 306

New Materials and Equipment

imperfect bonds between clad metals, switch contacts, bearing linings, cutting tool tips, and so forth.



Tongs for Handling Radioactive Material

Remote handling tongs for safe handling of radioactive material, either as solids or fluids in a beaker or flask, are now available at *The Atomic Center for Instruments and Equipment, Inc.,* 489 Fifth Ave., New York 17. Designed for the radiochemist, radiologist, and health-physicist, the Radiarm Jr.'s pistol handle is said to combine good leverage with comfortable grip for handling heavy or light objects.

The material, once grasped by the serrated tongs, is held by a spring pressure which can be released only by a deliberate trigger squeeze. The jaws can also be locked in a fixed position by adjusting the knurled nut at the grip end. The Radiarm Jr. weighs 1 lb and measures 19 in. from tip to tip. It is made of 24-ST aluminum, which is said to be easily decontaminated.

Laminated Precious Metal Contact Material

A precious metal contact material, laminated in ingot form through heat and pressure, and cold rolled to required dimensions has been marketed by the *D. E. Makepeace Co., Div. of Union Plate and Wire Co.,* Attleboro, Mass. The

Remington Rand Methods News

KEEPING A FINGER ON 12,000 ITEMS: For an over-all cost of 12½ clerical units, National Motor Bearing keeps accurate, centralized control of 12,000 different items in 7 plants and warehouses. This battery of automatic machines also simplifies payroll procedures and produces reports for analyzing all sales.

Money-saving short cuts in Production, Distribution and Accounting!

We wish you could talk with the Production and Sales people at National Motor Bearing Co. What they say about their new punched-card system makes mighty profitable listening. For example:

Cost Analysis: It used to take 30 days after the job was completed to get even the sketchiest information. Now high-speed punched-card machines have *complete,* accurate facts ready in *just 5 days!*

Inventory Control: National Motor Bearing's inventory turns over *fourteen times a year!* To get fast, up-to-date facts about 12,000 different items in 7 plants and warehouses, they use high-speed punched-card accounting. Old methods used to mean shortages, back orders, even lost orders. Today, N.M.B. inventory is better than *99% accurate!*

Production Control, Payroll Procedures: National Motor Bearings discovered that punched cards brought them amazing savings in time and money. These high speed automatic machines can give executives complete *daily* production reports. What's more, payroll procedures, are as a by-product, simplified and much faster.

We have prepared a complete Certified Report which gives you all the facts and figures of punched-card accounting at N.M.B. For your copy circle **CR752** at the bottom of the page and mail coupon today.

Stop trouble before it starts!

Your Preventive Maintenance Control must help catch breakdowns before they happen – OR ELSE!

Maintenance Executives, who have a hearty dislike of paperwork, always like our simplified visible systems. There's no confusion, little or no detail work. These visible records: (1) signal the inspection date, (2) permit scheduling of work ahead, (3) pinpoint location of equipment, (4) chart depreciation.

Let us show you how Preventive Maintenance Control can help prevent breakdowns . . . keeps your plant equipment humming. Simply check **KD705** at the right and drop the coupon in the mail.

Why operate a Personnel Department the hard way?

Let our manual of personnel administration record keeping show you money-saving short cuts you can take. This manual shows how specific skills can quickly be located. It tells how to answer 80% of all Personnel Department phone calls—in mere seconds. It points out how you can maintain control over punctuality, vacations, etc. And it gives you examples of other profitable Personnel Department procedures. Ask for **X521.**

No chance for error!

How do *you* process customer orders? Typing a master copy for duplicating is one way to begin, but even the most expert typists make errors—and duplicating does take time.

Moog Industries, Inc., of St. Louis discovered that our photocopy equipment speeds up order processing like magic . . . assures 100% accuracy. For the complete photocopy story at Moog Industries and how it can be used efficiently by your firm, ask for **CR856.**

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Profit-Building **IDEAS** For Business

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Now...a new and STRONGER MOLDING MATERIAL

...highest ever in high-impact phenolic!

Durez now offers you a phenolic plastic molding material having an impact or shock strength in foot-pounds per inch (Izod) ranging up to 27.

This compares favorably with some metals. It is several times as great as the impact strength of molding compounds in general use, the highest impact commercially practical in phenolics to date.

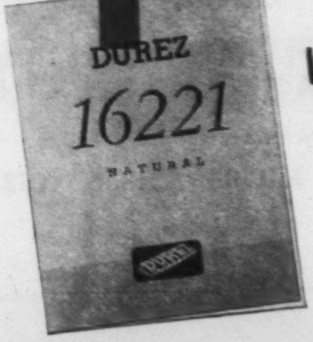
Fiberglas*, the strengthening agent, is used in a manner that conserves the industrially valuable properties of Durez molding phenolics.

Known as Durez 16221, the new material invites consideration for a large variety of applications. It has excellent dimensional stability, a high modulus of elasticity, good electrical properties and resistance to water, heat, and chemicals. It will withstand far higher service temperatures than cellulose-filled materials.

Fiberglas*-filled Durez 16221 is natural in color, comes in dry form, and is readily molded by standard compression methods. It produces parts or components having dependably uniform characteristics.

As specialists in phenolics for 32 years, we offer you the counsel of our field technical staff in investigating the profitable application of Durez 16221, which is now in commercial use.

*Owens-Corning Fiberglas



Want More Facts and Figures?

Send for folder DUREZ "16221 Natural"
DUREZ PLASTICS & CHEMICALS, INC.
1410 Walck Road, North Tonawanda, New York

DUREZ
PHENOLIC RESINS
MOLDING COMPOUNDS
INDUSTRIAL RESINS
PROTECTIVE COATING RESINS

PHENOLIC PLASTICS THAT FIT THE JOB

For more information, turn to Reader Service Card, Circle No. 451

New Materials and Equipment

manufacturer says the precious metal is hard rolled to produce dense, hard contact surfaces with good electrical and mechanical qualities. Costly assembly operations are said to be reduced to blanking costs since there is no waste of the precious metals.

Called "Raised-Lay", the material consists of one or more ingots of precious metal bonded to a base metal. The base metal is in strip form while the contacts are in the form of a ridge, and the bar can be laminated into various strip widths or thicknesses.

The material is presently being used by General Electric in a.c. motor starters.

Profilometer Tracers Measure Roughness in Holes

Six Profilometer LE-type Tracers for taking surface roughness measurements in holes as small as ½-in. i.d., as deep as 24 in., and from 1 to 75 microinches roughness, are now available from the *Micrometrical Mfg. Co.*, 345 S. Main St., Ann Arbor, Mich.

In order to enter small, deep holes, the Tracers have an integral Linkarm or Stiffarm, each available in three standard lengths for measuring to maximum depths of 9, 18 and 24 in.

Tracers with Linkarm are intended for operation by means of a motor-driven Mototrace, but can be used for hand tracing if desirable. Tracers with Stiffarm are intended for manual operation, but can be used with a Mototrace by attaching the Stiffarm to a standard Linkarm. All tracers can be used with any Profilometer Amplimeter.

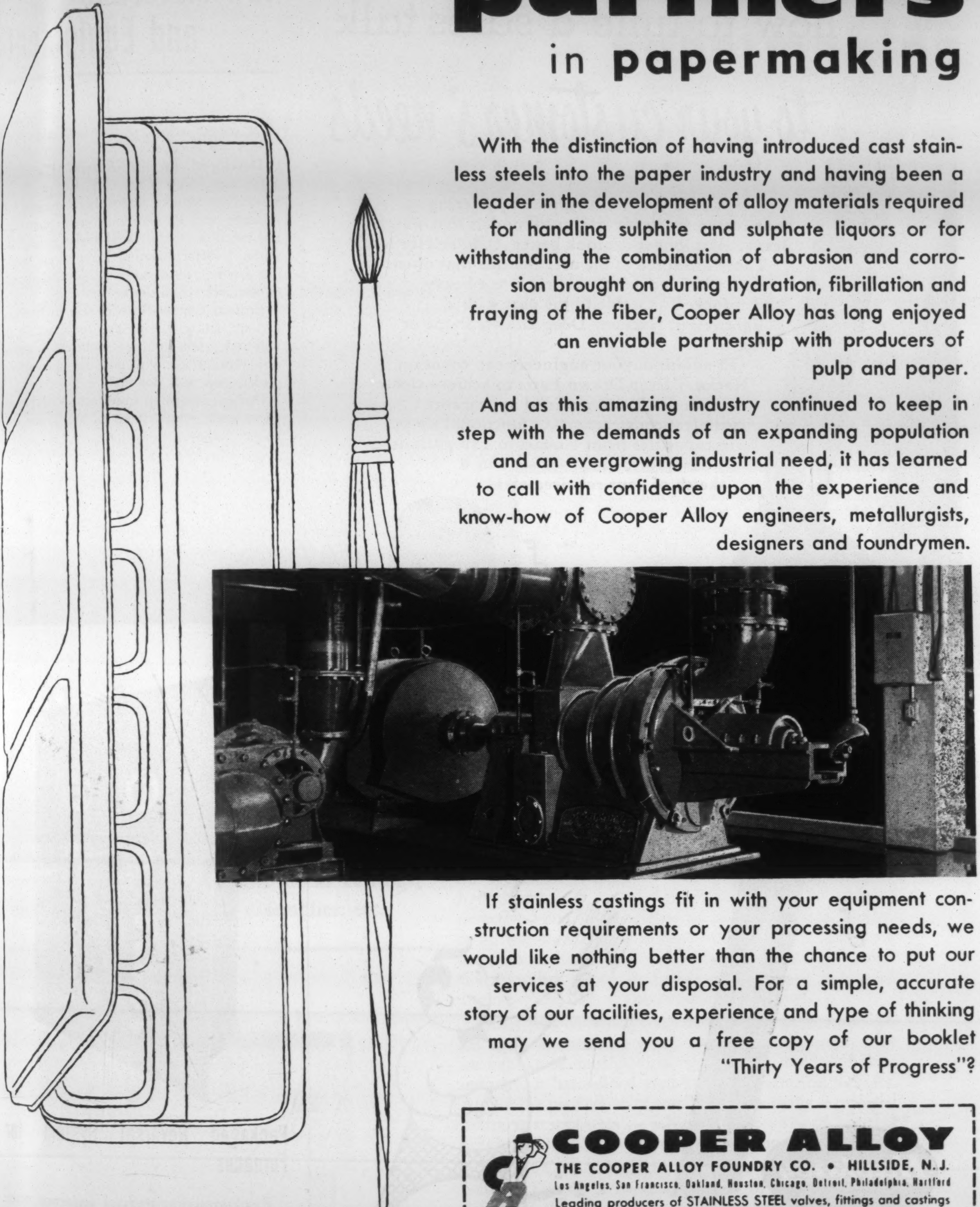
Dip Process Provides Passivation of Copper

Standard bright-dips such as nitric and sulfuric acid and various chromate dips, remove oxides quickly, but reoxidation begins shortly after the original immersion. Through the recent development of a chemical dip and rinse process, it is now possible to passivate copper and

partners
in papermaking

With the distinction of having introduced cast stainless steels into the paper industry and having been a leader in the development of alloy materials required for handling sulphite and sulphate liquors or for withstanding the combination of abrasion and corrosion brought on during hydration, fibrillation and fraying of the fiber, Cooper Alloy has long enjoyed an enviable partnership with producers of pulp and paper.

And as this amazing industry continued to keep in step with the demands of an expanding population and an evergrowing industrial need, it has learned to call with confidence upon the experience and know-how of Cooper Alloy engineers, metallurgists, designers and foundrymen.



If stainless castings fit in with your equipment construction requirements or your processing needs, we would like nothing better than the chance to put our services at your disposal. For a simple, accurate story of our facilities, experience and type of thinking may we send you a free copy of our booklet "Thirty Years of Progress"?

COOPER ALLOY

THE COOPER ALLOY FOUNDRY CO. • HILLSIDE, N.J.

Los Angeles, San Francisco, Oakland, Houston, Chicago, Detroit, Philadelphia, Hartford

Leading producers of STAINLESS STEEL valves, fittings and castings

☐ Please send your new booklet "Thirty Years of Progress"

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how to tune a sales talk

to your customers' needs

Could you build volume by offering your customers newly-designed models that weigh less . . . last longer . . . look better . . . or sell for less? These are some of the user benefits that often result when manufacturers replace a heavy cast, forged or welded pipe part with a lightweight Hackney Deep Drawn Shape or Shell.

In addition, your engineers can count on Hackney Deep Drawn Parts to achieve closer tolerances . . . streamlined appearance . . . seamless construction . . . functional shapes in capacities from 1 quart to 150 gallons. Write for details—or send us a sketch of your requirements.

More than 50 years of specialized experience go into the development of Hackney Parts like these.

Hackney
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Pressed Steel Tank Company

Manufacturers of Hackney Products

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CONTAINERS FOR GASES, LIQUIDS AND SOLIDS

For more information, turn to Reader Service Card, Circle No. 322

New Materials and Equipment

most copper alloys at the same time the oxides are removed.

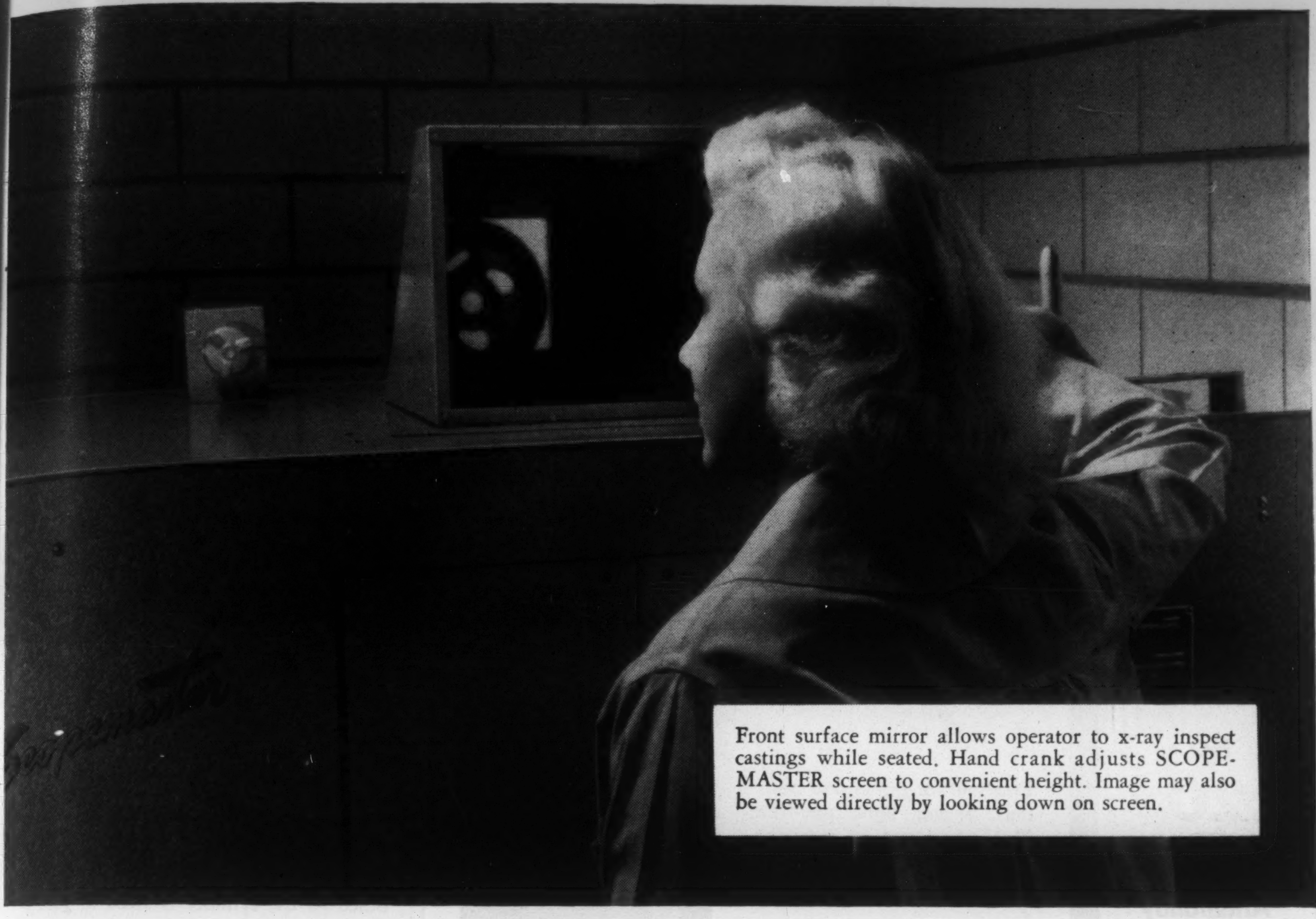
Developed by the *Rossaul Co.,* 170 Fifth Ave., New York City, Copper-Brite is said to remove atmospheric oxides in minutes and to simultaneously passivate the metal so that it will resist oxidation without surface coating for periods ranging from 3 to 6 months, depending on atmospheric conditions.

Rossaul Copper-Brite is safe to handle, and no special drains are required; it is non-toxic, non-fuming, requires no special ventilation, will not discolor silver solder, and will not etch.

One-gal sampling units are available at $4.50 each, while standard units are the 13-gal carboys.

Packaged Reversal System for Furnaces

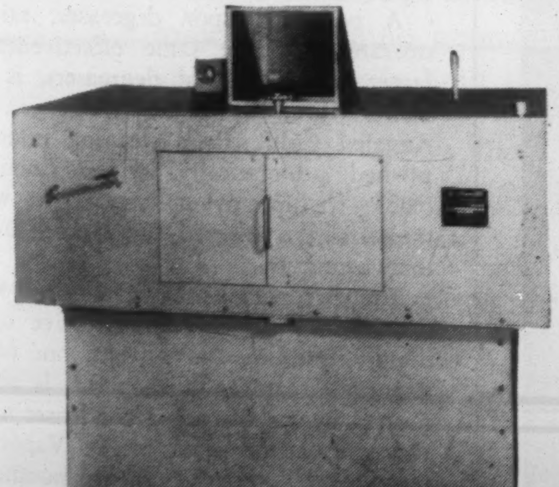
Fast, unvarying reversal sequence with all steps electrically interlocked for safety is said to be a feature of the new automatic reversal system for open hearth, regenerative soaking pits and glass tanks, now available at *Askania Regulator Co.,* 240 E. Ontario St., Chicago Ill. Reversals can be initiated automatically by elapsed time or checker temperature, or semiautomatically by push button on the control panel, the company states. The pistol



Front surface mirror allows operator to x-ray inspect castings while seated. Hand crank adjusts SCOPEMASTER screen to convenient height. Image may also be viewed directly by looking down on screen.

Reduce costs! Use GE Scopemaster for 100% visual x-ray inspection

Provides more than ample sensitivity in high-speed examination of light-metal castings, molded plastics, intricate assemblies, etc.



SCOPEMASTER's screen-object distance can be varied to magnify image, and a single control moves the sample longitudinally or transversely. Unit is fully protected for stray radiation.

100% fluoroscopic x-ray inspection can prove a valuable tool in your plant. Pioneered for the aircraft industry, the GE SCOPEMASTER saves producers and users of light metal alloy castings time and money in catching defective parts. The accuracy of its inspection is attested by its use on airframe castings where failure could cause a serious accident. It is vastly superior to sample inspection by other means, and costs are far lower than with any other method of comparable thoroughness.

Other jobs on which x-ray fluoroscopy has been successful include checking small electrical components for incomplete or improper assembly. In the molded plastics industry, it has helped establish manufacturing technics. And in the production of small ordnance items, it replaced destructive spot tests — salvaged 90 to 98% of lots that previously would have been rejected in their entirety.

The SCOPEMASTER is another example of how General Electric is harnessing x-ray to the needs of industry. If there's a testing or inspection trouble spot in your plant, x-ray may be the answer. Ask your GE x-ray representative for an evaluation, or write your requirements to X-Ray Department, General Electric Company, Milwaukee 1, Wisconsin, Rm. AZ-10.

GENERAL ELECTRIC

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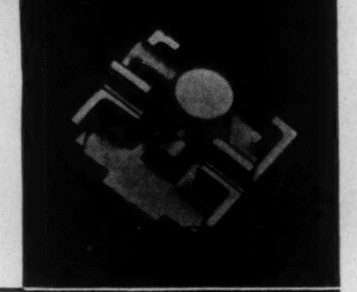
ATLANTALLOY

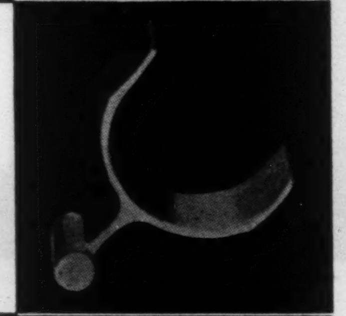
PLASTER MOLD CASTINGS CAN SOLVE YOUR DESIGN PROBLEMS

Atlantalloy plaster mold precision castings provide non-ferrous castings *cast to ordinary machining tolerances*, effecting definite savings in machining and other costly operations. Atlantalloys are characterized by high strength, durability, and many other advantages.

NO. 10 YELLOW BRASS *Atlantalloy* — An all-purpose alloy for brush boxes, gears, levers, etc. Fine grain, clean, smooth surfaces assure tightness. Easily machined. Free from porosity. Fatigue resistant.

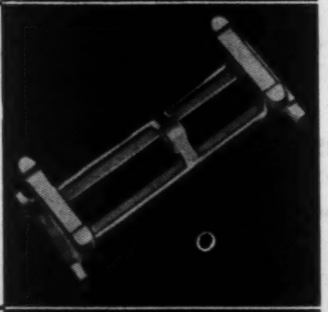


NO. 20 ALUMINUM BRONZE *Atlantalloy* — Excellent for gears and bearings. Strong, light, zinc-free. Highly resistant to corrosion. Machines well.

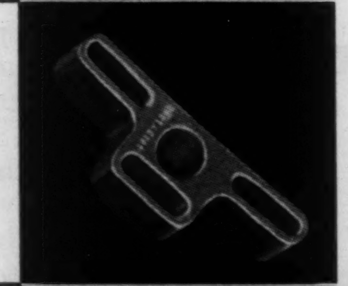


NO. 31 *High Tensile* MANGANESE BRONZE *Atlantalloy* — High strength engineering material for gears, valve bodies, electrical mechanisms, etc. Extremely durable. No heat treatment needed. Can be cast in thin sections.

NO. 40 *High Strength* ALUMINUM *"Tenzalloy"* — Attains high strength through natural aging. Free from internal stress and skin hardness. Ideal for machining.



NO. 60 ALUMINUM *Atlantalloy* — Perfect as instrument alloy. Fully uniform with no internal strain. Can be used for accurate, thin-sectioned castings.



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New Materials and Equipment

grip switch gives operator control, while panel lights indicate firing conditions and reversal sequence.

New Machine for Plastics Fabricators

For the manufacturers of plastic cylinders, the 1954 Taber Sheet Plastic Cylinder Maker is said to minimize rejections due to the automatic sizing which eliminates crooked seams and misfitting bodies.

Manufactured by the *Taber Instrument Corp.,* 111 Goundry St., N. Tonawanda, N. Y., the machine is equipped with "Auto-size" expanding mandrels having a range of 2½ to 8½ in. and new sliding gages. The expanding mandrels and sealing bar, actuated by a foot treadle, are timed so the cylinder is sized to just the dimension desired before the seam is sealed.

Mandrel expansion of 1/16 in. brings the cylinder up to precision size, and subsequent contraction allows removal of cylinder when the foot treadle is returned to starting position.

The 10- by 1½-in. sealing bar is electrically heated by means of a resistance heater equipped with adjustable thermostat temperature control.

Portable Vapor Degreaser

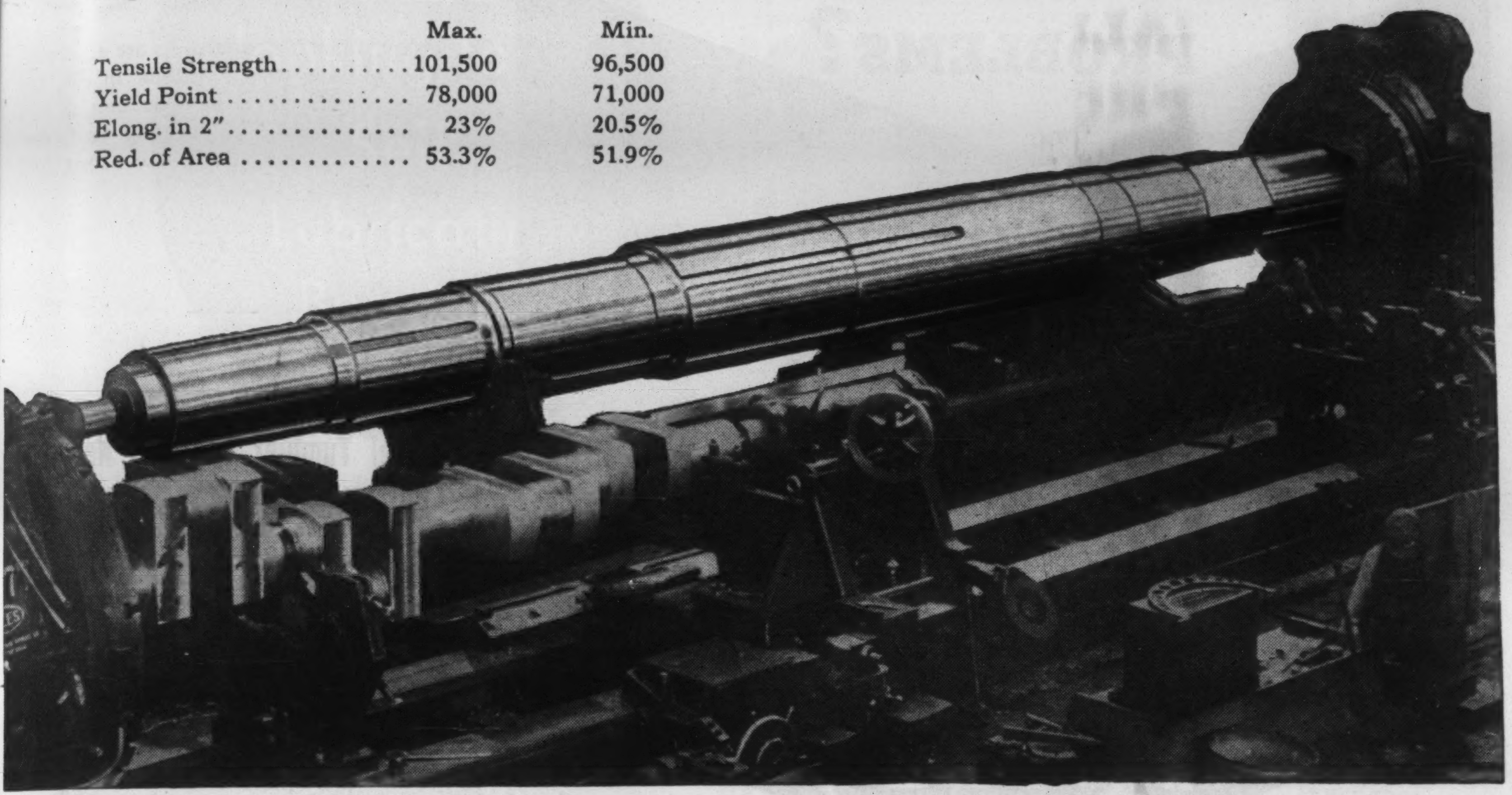
A portable vapor degreaser, said to operate with the same effectiveness as larger type industrial degreasers, is now manufactured by *Baron Industries,* Los Angeles, Calif. Parts cleaning is accomplished automatically in pure, nonflammable trichlorethylene vapors, in which the parts are lowered and cleaned in less than a minute.

The Baronet degreaser requires 5 gal of cleaning solvent for effective operation. Reclaiming the solvent, one of the important features of the unit, is accomplished by an air-cooled condenser which also controls the vapor height. Vapors are generated by electric elements mounted in the base of the assembly, and thermostat control insures operational safety and maximum economy.

The Baronet is a standard 50-gal barrel-type unit and can be installed in ecah work area wherever electric power is available. No water connections are nec-

NICKEL STEEL FORGING . . . a 58,950 lb. hoist drum shaft, 24" in diameter at its widest portion and 42' 9" long, produced by ERIE FORGE & STEEL CORP. Inspection revealed very fine grain. After being normalized and drawn, actual tensile tests in the longitudinal direction showed the following:

	Max.	Min.
Tensile Strength	101,500	96,500
Yield Point	78,000	71,000
Elong. in 2"	23%	20.5%
Red. of Area	53.3%	51.9%



How Erie Forge Obtains Superior Properties in Large Forgings

To develop high tensile and elastic properties in large forgings, such as this giant shaft, by heat treatment is much more difficult than with smaller forgings.

For even though dimensions of a large piece may allow liquid quenching, section sizes involved ordinarily limit the cooling rates.

Experience shows that superior mechanical properties in large forgings depend largely on suitable alloy content . . .

Fundamentally, that is why the output of ERIE FORGE & STEEL CORPORATION of Erie, Pennsylvania, includes scores of large forgings produced from nickel alloyed steel.

Nickel, either alone or in combination with other alloying elements, exerts highly beneficial influences. Its strengthening effect on ferrite is independent of carbon content or heat treatment of the steel, while its effectiveness in reducing the rate and temperature of the upper transformation, induces better response to the necessarily milder heat treatments used.

Nickel alloy steels may help you obtain peak performance from vital parts of *your* products or equipment. Send us the details of your problems for our suggestions. Write us now.

At the present time, nickel is available for end uses in defense and defense supporting industries. The remainder of the supply is available for some civilian applications and governmental stockpiling.

EMBLEM OF INCO SERVICE

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET
NEW YORK 5, N. Y.

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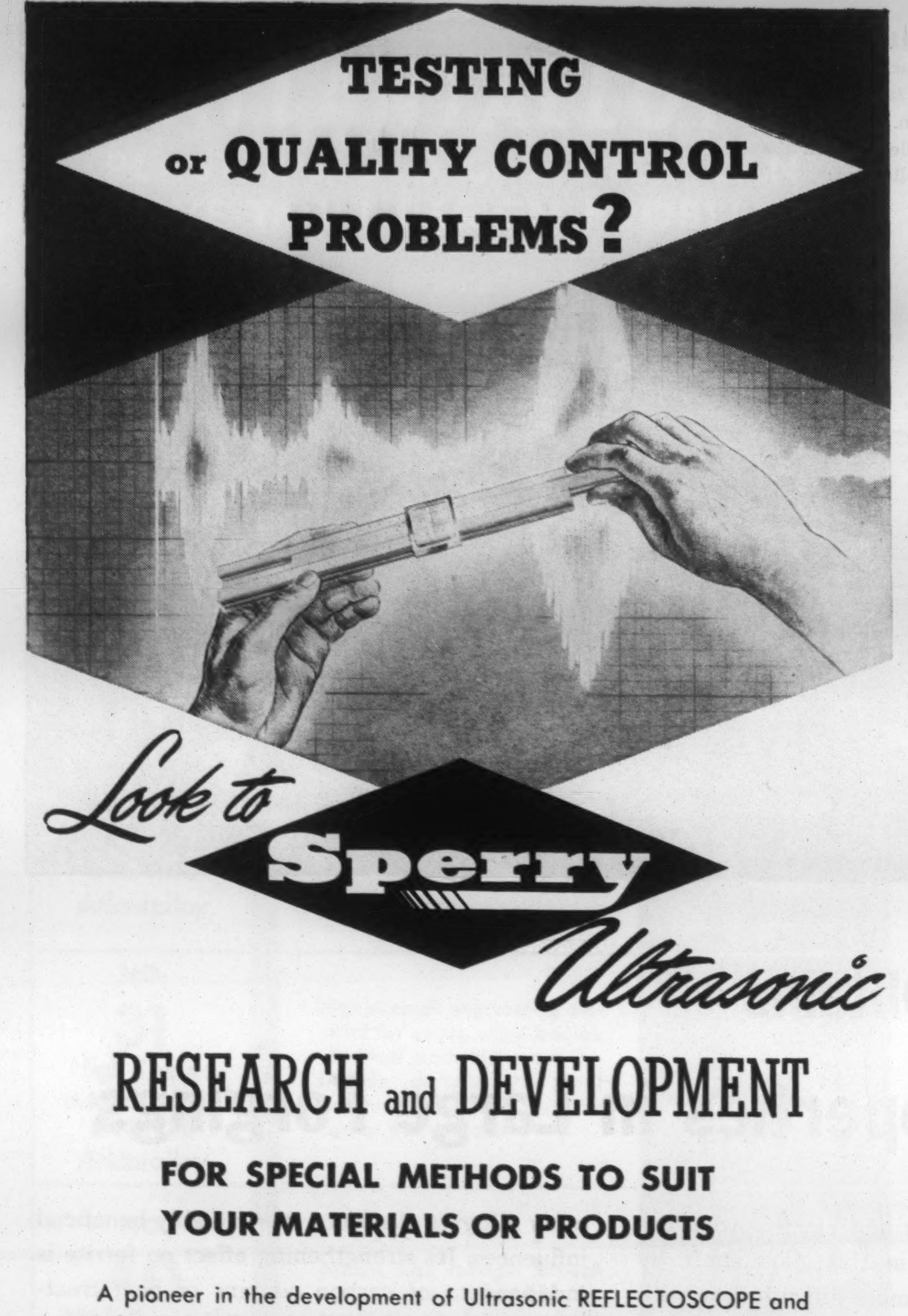

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New Materials and Equipment

essary, since the condensers are air-cooled. The working area is 23 in. in dia, and vapor depth is 18 in. The unit is sold equipped with 2-kw heating unit, condensing chamber, thermostat, 15-ft cord and cover.

Barrel Tumbler Features Neoprene Lining

Sturdy construction and a neoprene liner are said to be two features of a new barrel tumbler developed by *White-Roth Machine Corp.*, Lorain, Ohio. The unit is of welded steel construction with the exception of the barrel door, which is made of aluminum for ease of installation and removal. The insides of both barrel and door have neoprene linings that extend barrel life and assure quiet operation.

The BurrMaster removes welding slag, flame cutting slag, burrs and rust from weldments and machined parts. All moving parts are enclosed, and the perforated exterior barrel guard is locked in the lowered position during operation.

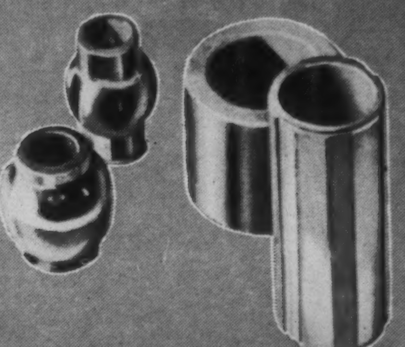
The variable speed drive allows the unit to be set at any desired barrel rpm from 5 to 30. Push button control makes it possible to position barrel door for convenient unloading and draining, and the self-locking drive prevents the barrel from moving during loading or unloading. An electric timer leaves operater free during the deburring cycle and automatically shuts off the equipment when the cycle is completed.

The BurrMaster barrel is 32 in. in dia and 48 in. long, with a total load capacity of 2000 lb. Overall dimensions of the unit are 72 in. high and 62 in. long.

Automatic Furnace for Rod End Heating

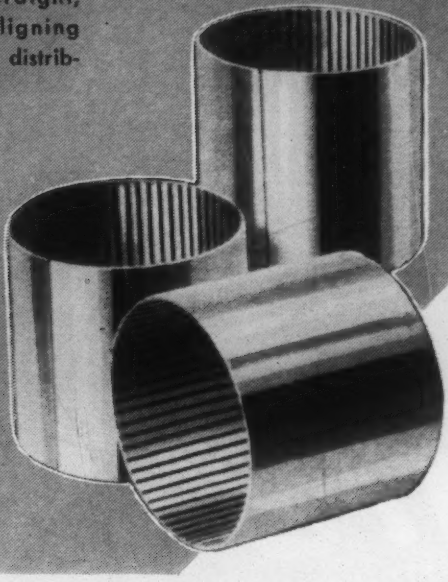
A new furnace designed for the production heating of rod ends has been marketed by the *Gas Appliance Service, Inc.*, 1211 Webster St., Chicago. Using production figures based on heating a 4-in. end-section of ½-in. dia rod, the new "Hot Rod" End Heating Unit is said to bring rod ends to 1900 F in 50 sec, with an hourly production rate of 900 rods.

Are you looking for a Self-Lubricating Bearing?



JOHNSON LEDALOYL Self-Lubricating BEARINGS

● Produced by powder metallurgy—molded pre-cast bronze alloy—these bearings are impregnated with oil. Made to order in large quantities of a size. A large selection of straight, flanged and self-aligning sizes available from distributor stocks.

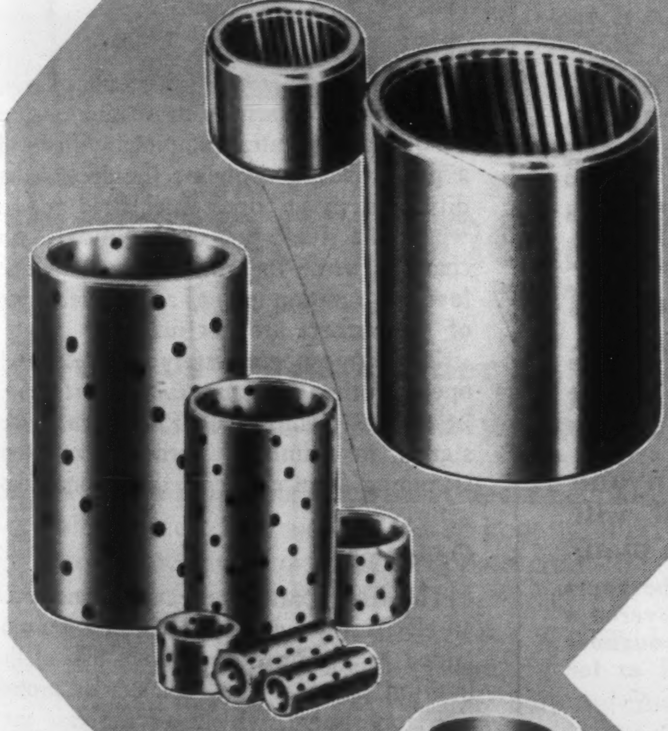


JOHNSON GRAPHITED SHEET BRONZE BEARINGS

● Serrated type. Made to order in wide range of sizes. Low cost in quantities of a size.

JOHNSON GRAPHITED CAST BRONZE BEARINGS KR SERRATED TYPE

● Provides 40 to 45% graphite contact with shaft, increasing slightly with wear. This type is a standard stock item in over 200 sizes, available from Johnson Distributors. Other sizes made to order.

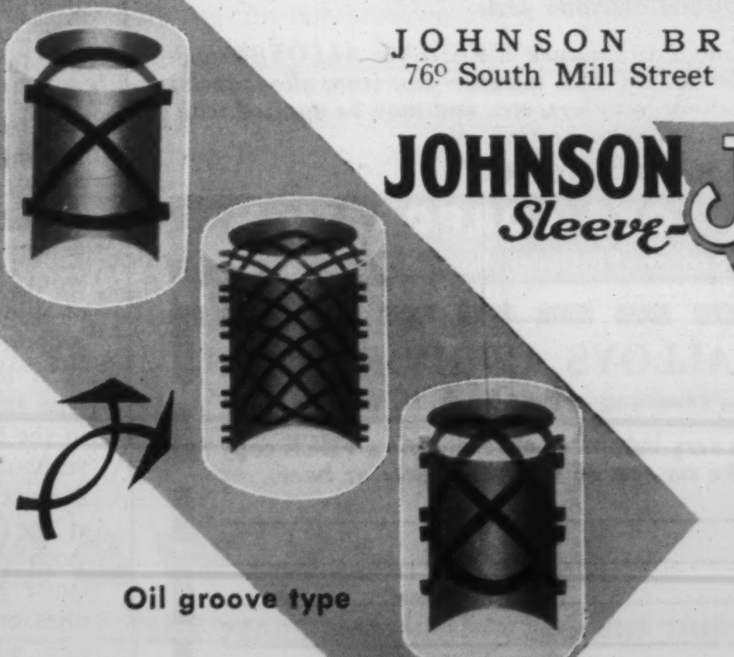


PLUG TYPE GRAPHITED CAST BRONZE BEARINGS

● Stick graphite is forced into drilled holes. Made to order in any size, or produced from any of 900 Standard Stock Size Johnson GP Bearings.

OIL GROOVE TYPE GRAPHITED CAST BRONZE BEARINGS

● Oil grooves serve as recesses to hold graphite. Made to order in any size, or produced from any of 900 Standard Stock Size Johnson GP Bearings.



Oil groove type

JOHNSON GRAPHITED BRONZE BEARINGS and JOHNSON LEDALOYL (Powder Metallurgy) BEARINGS meet such requirements. They were developed primarily for applications where lubrication is difficult or likely to be neglected. Where shaft speed is too slow or the temperature too low to sustain an oil film, use a Johnson Graphited Bearing. If high operating temperatures may burn out oils and greases, your answer may be a graphited bearing. They are recommended, too, where lubricants may damage goods or foods in process, where dripping oil cannot be tolerated, and in certain underwater applications. Johnson Ledaloyl Self-Lubricating Bearings are impregnated with oil, which is metered to the shaft in operation, reabsorbed when at rest. They are especially desirable for sealed-in applications. Johnson Engineers will gladly help you select the correct sleeve bearing for the job. Write for full information.

JOHNSON BRONZE COMPANY
760 South Mill Street • New Castle, Pennsylvania

JOHNSON JB BEARINGS
Sleeve-Type

OTHER JOHNSON BEARING TYPES . . .

General Purpose (GP) • Electric Motor (EM) • Universal Bronze Bars • Babbitt Metal

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EUTECTIC

New Materials and Equipment

Designed with conveyor and automatic hopper feed, it is said to handle stock sizes of rod from ¼ to 1½ in. in dia with varying number of burners to meet the particular stock and production requirements. Length of section heated may be up to 4 in., and over-all length of pieces from 6 to 24 in.

The new unit is particularly suited for rod end upsetting, bolt heading, swaging, localized hardening, etc., and its use is said to result in a noteworthy saving in production time and cost.

Atmosphere Safety Unit for Furnaces

Explosions in furnaces fall into two categories: under one condition air infiltrates into a furnace or vestibule which is normally operated completely filled with a protective atmosphere; the second condition is in an open fuel fired furnace when the fuel gas enters the furnace chamber while the chamber walls are below the ignition point, and at least part of the burners are not firing.

The atmosphere safety device, developed by the *Ferguson Equipment Corp.*, 21st St. & Penn. Ave., Pittsburgh, is designed to eliminate furnace explosions stemming from either of these conditions.

Operation

The basic part of the unit consists of an electrically heated tube which is maintained at a temperature above that of the ignition point of the fuel gas or protective atmosphere, whichever the case may be. In the open fired furnace the tube would be installed at the top of the furnace and protrude into the chamber. Any gas introduced or leaking into the chamber would tend to collect first at the top of the chamber because of the lighter density of the gas, and the heated tube would burn it in small quantities instead of allowing it to build up to explosive proportions.

In the case of protective atmosphere type furnaces, the unit would be located in the bottom of the chamber or attached vestibule since any air infiltrating into these enclosures would tend to remain at the bottom until mixed with the atmosphere. The safety unit would then ignite the infiltrating air in small quantities before enough air could gather and mix with the atmosphere to cause an explosion during the next operation of the furnace.

For the long haul... Autocar relies on RB&W bolts

Famous truck builder rates them best for ease of assembly and accessibility

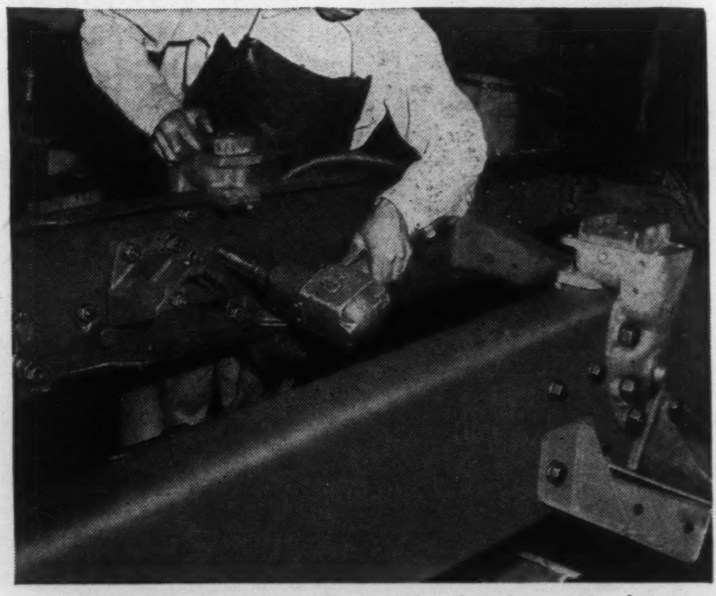
It's been a long time since the Autocar people switched from riveted to bolt-and-nut construction. Here's how it happened:

Two Autocar engineers took off on a coast-to-coast run to shake the bugs out of a new test model. Things went well until a riveted spring bracket broke. It took an entire day just to chisel through the rivets because it was hard to get at the bracket.

From that day on, it was *accessible* bolt-and-nut construction exclusively for all Autocar trucks. And Autocar standardized on RB&W bolts. One dividend from using these rugged bolts is that Autocar can specify higher-strength material than is practical for riveting. Furthermore, tests on structures like bridges show that rivets frequently loosen. This doesn't happen to bolts on Autocar frames.

Where you want to join structural members firmly together so they'll *stay* together for good, high-strength bolting is often your best bet.

As the leading manufacturer of all kinds of fasteners, we're in the unusual position of always being able to recommend and supply the right ones for all your needs. Write to RUSSELL, BURDSALL & WARD BOLT AND NUT COMPANY, Port Chester, N. Y.



FASTER FASTENING is achieved in the Autocar plant at Ardmore, Pa., by using air tools like the one shown here to run up RB&W nuts on RB&W bolts on an Autocar truck frame. In addition to making tight, accessible joints, bolting effects substantial assembly savings.

3,1

RB&W

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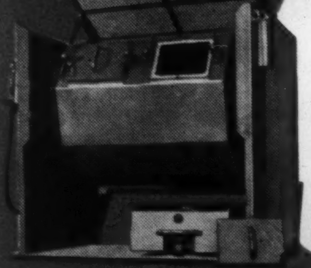

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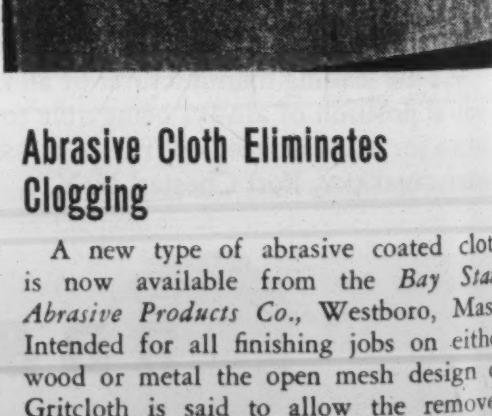
Safety Feature

A control system is incorporated in the unit, which indicates both audibly and visually when the temperature of the ignition unit falls to a point dangerously close to the ignition point of the gases in use. For operation in unheated vestibules, the control unit has a coil current relay through which the current is supplied to the heating element.

Should the current draw fall below a specified value, the relay is actuated, causing the two pilot lights to go out and also an alarm horn to sound. In the event of the device drawing too much current, a circuit breaker actuates the same alarm circuit.

A second type control must be used where the unit is located in the furnace chamber where the operating temperature is high enough so that an uncontrolled unit would be destroyed by excessive rise in temperature. Control of this unit is accomplished by an automatic temperature control pyrometer having two independent control points, one at the desired operating temperature and the other at the minimum temperature where it is desired to have the alarm functions actuate.

Both of these units have extra relay contacts which can be used to provide desired functions such as shutting down the furnace, etc.



Abrasive Cloth Eliminates Clogging

A new type of abrasive coated cloth is now available from the *Bay State Abrasive Products Co.,* Westboro, Mass. Intended for all finishing jobs on either wood or metal the open mesh design of Gritcloth is said to allow the removed particles to flow through the cloth and not clog the abrasive teeth.

The company states that its new

NEW PLASTIC MATERIALS ADD PROPERTIES NATURE FORGOT

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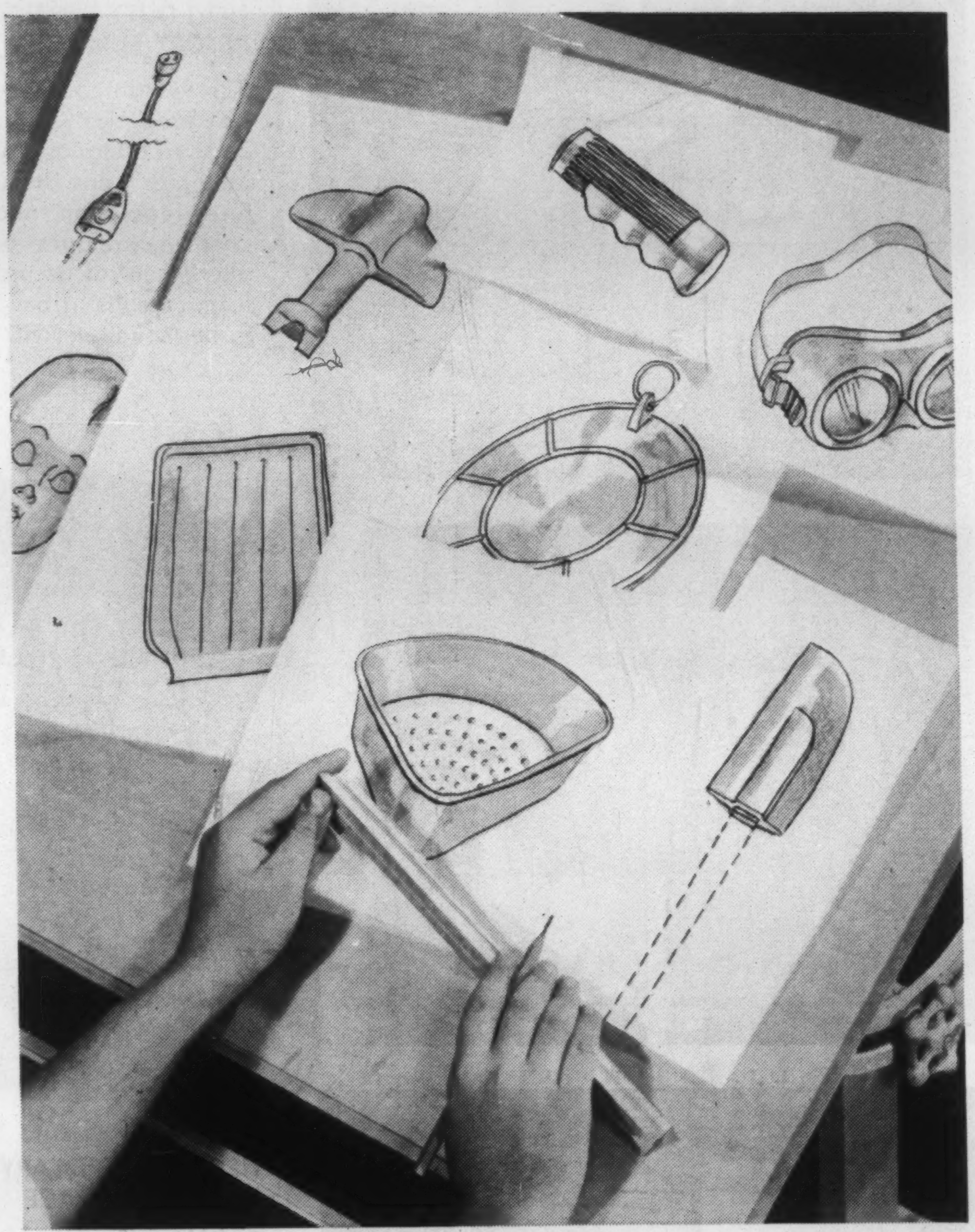
For many manufacturers (and you may be one), better, faster selling, more versatile products will be a reality tomorrow . . . because of new, improved materials uncovered by Monsanto research today.

For example: Monsanto recently developed a new technique for molding its Opalon vinyl resin . . . which greatly widens the range of applications for injection molding vinyl chloride. Typical of the vast research daily devoted to plastic materials, processes and applications, this latest development in the injection molding of Opalon dry blend vinyl resin opens new design opportunities for manufacturers of electrical equipment, flexible fittings, appliances, sporting goods, housewares, toys and many industrial products.

Perhaps you, too, have a use for Opalon—or another Monsanto plastic—in your present products, or ones still on the drawing board calling for properties possible with one of the new plastics. You'll find answers to many of your questions about these new materials in Monsanto's latest report to management. Send for your *free* copy today; the coupon is for your convenience.

Opalon: Reg. U. S. Pat. Off.



For products such as automotive and refrigeration parts, sporting goods, toys, housewares, etc., Monsanto's Opalon vinyl plastic delivers flexibility ranging from soft to semi-rigid . . . outstanding electrical properties . . . resistance to abrasion, moisture, oxidation, most acids, alkalies and common solvents . . . and a wide range of color.

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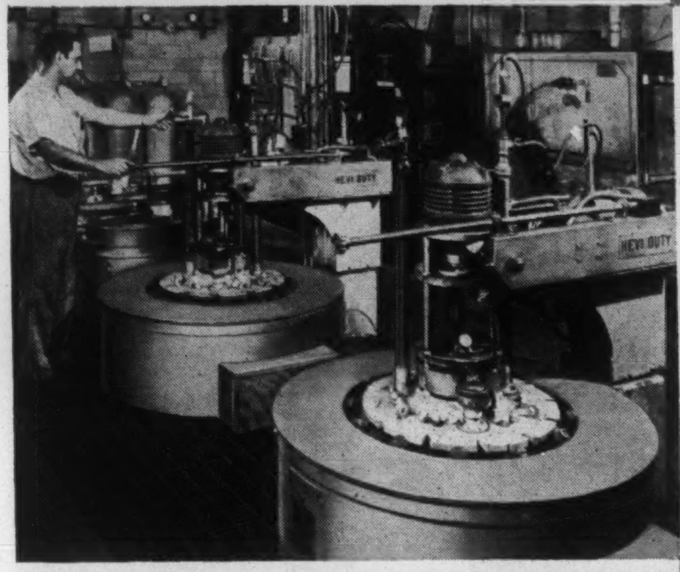
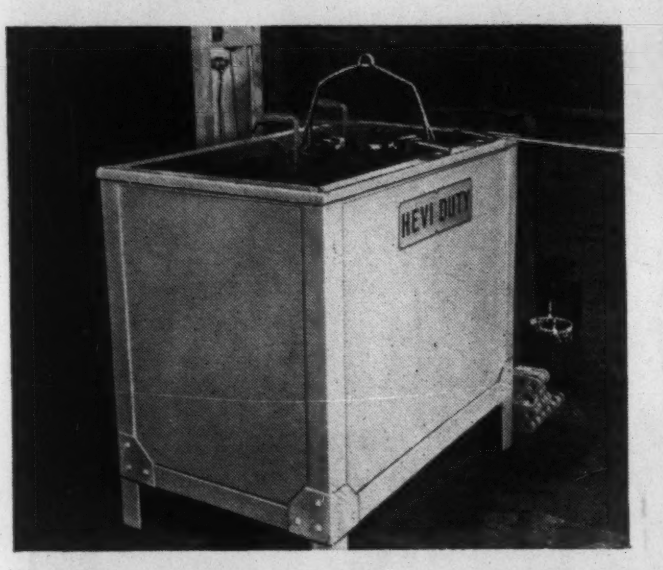
HEAT TREATING FURNACES for INDUSTRY



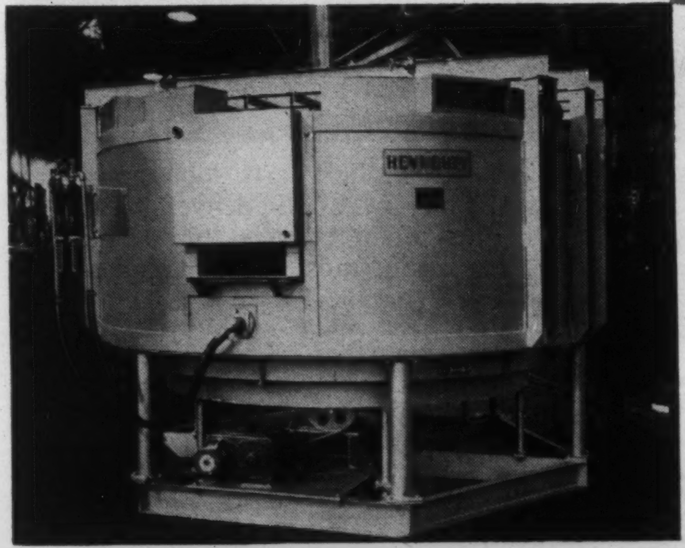
HEVI DUTY VERTICAL RETORT FURNACE

This versatile furnace may be used for all major heat treating operations. Multiple zone temperature regulation and the positive pressure atmosphere control assure uniform results from heat to heat. Bulletin HD-646.



HEVI DUTY OIL BATH TEMPERING FURNACE

Even heat at exact temperatures. Continuous agitation of the oil gives the surface of the bath an appearance of boiling though the bath is without gas pockets. Bulletin HD-336.



HEVI DUTY ROTARY HEARTH FURNACE

Designed to operate at temperatures up to 2500° F. Many of these furnaces are heating jet engine parts prior to forging. A protective atmosphere prevents scale and the decarburization of high temperature alloys. Maximum capacity is 1500 pounds per hour. Bulletin 153.

At your service are experienced Hevi Duty Engineers able to recommend that exact furnace for your production system.

HEVI DUTY ELECTRIC COMPANY
MILWAUKEE 1, WISCONSIN
Heat Treating Furnaces . . . Electric Exclusively
Dry Type Transformers *Constant Current Regulators*

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New Materials and Equipment

product can be used on both sides, wet or dry, flat or folded, by machine or hand, and that tests have shown Gritcloth to possess 10 to 15 times the life of most ordinary coated papers.

It is now available in grit sizes of 280, 320, 360, 400, 500, and 600, and manufacturing facilities will soon include sizes 180, 220, and 240. Sheet sizes range from 3¼ by 4 in. to 9 by 11 in., with an 8 in. dia, no hole disk also available.

Electric Heating Element

New heating elements designed and developed for higher watt densities and for longer life in critical temperature applications have been marketed by *Thermel, Inc.*, 3440 W. Lake St., Chicago.

Intended for use in injection molding machines, preplasticizers, heating forms for shell molding and other such applications, the Thermacartridges are manufactured to a close tolerance on the outside diameter, facilitating installation in a reamed hole.

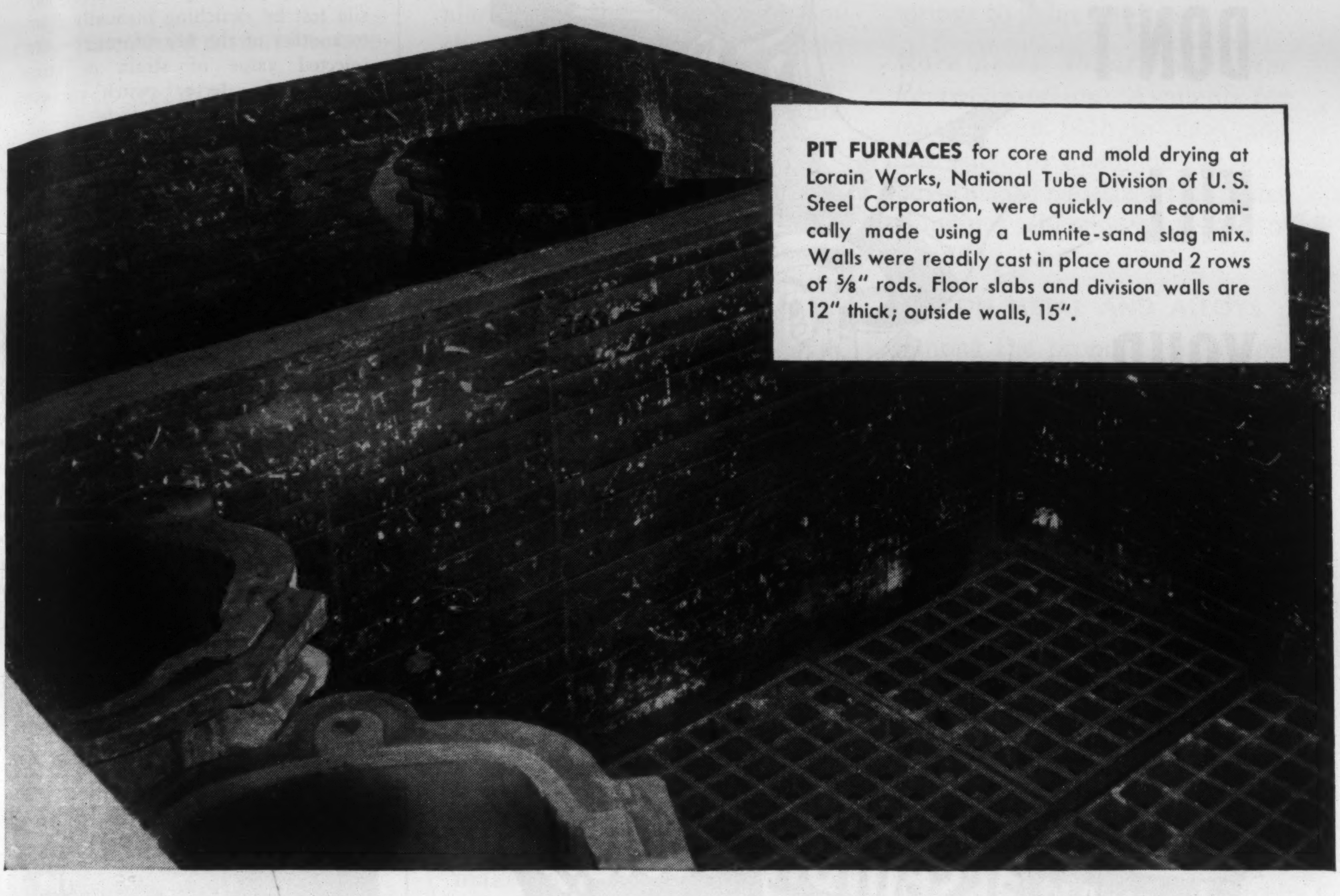
The design of the element permits manufacture in lengths from 1 to 12 in., and ⅜ to ¾ in. dia.

New Microformer Type Extensometer

A Microformer type extensometer designed to produce stress-strain diagrams with high strain magnification below and low strain magnification above the elastic limit of materials has been marketed by *Baldwin-Lima-Hamilton Corp.*, Philadelphia, Pa. The new Baldwin TS-M Dual Extensometer employs variable miniature transformers for transmission of strain variations.

Ten strain magnifications ranging from 5:1 to 200:1 are provided by means of Microformers at three positions on extensometer slide and horizontal arms, by the use of extension arms, and by the selection of three magnifications available in the Microformer recorder. Dual mag-

Heat Resistant Concrete in pit furnaces still sound after two years' hard use



PIT FURNACES for core and mold drying at Lorain Works, National Tube Division of U. S. Steel Corporation, were quickly and economically made using a Lumnite-sand slag mix. Walls were readily cast in place around 2 rows of 5/8" rods. Floor slabs and division walls are 12" thick; outside walls, 15".

THESE PIT FURNACES for core and mold drying get bumped and nudged as heavy multi-ton core molds are hoisted in and out. In addition, the Lumnite Concrete is subjected to heating-cooling cycles that damage regular concrete. But over 2 years' continuous service to date proves that Heat-Resistant Concrete made with Lumnite can take it!

Lumnite Concrete has low volume change needed to withstand periodic heating-cooling cycles and thermal shock. Also there are no small units or joints in smooth monolithic construction which could be loosened by either periodic heating or catching projections on the huge molds.

Lumnite Concrete saves time and money from the start. One-piece walls are simply cast in place or "shot" on by cement gun. And Lumnite Concrete reaches service strength in 24 hours or less. So construction or repairs go *fast*.

This speed and economy pays off on many other jobs. Make heat-resistant, refractory or insulating refractory concrete (to 2600°F. service) simply by using a suitable aggregate and Lumnite calcium-aluminate cement.

FOR CONVENIENCE—use castable refractory mixes of Lumnite and selected aggregates to meet specific temperature and insulation requirements. Made by manufacturers of refractories and sold by their dealers. For more information write: Lumnite Division, Universal Atlas Cement Company (United States Steel Corporation Subsidiary), 100 Park Avenue, New York 17, N. Y.

*"*LUMNITE" is the registered trade mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.*

MM-L-67RR

ATLAS® **LUMNITE for INDUSTRIAL CONCRETES**

REFRACTORY, INSULATING, OVERNIGHT, CORROSION-RESISTANT

A UNIVERSAL ATLAS PRODUCT

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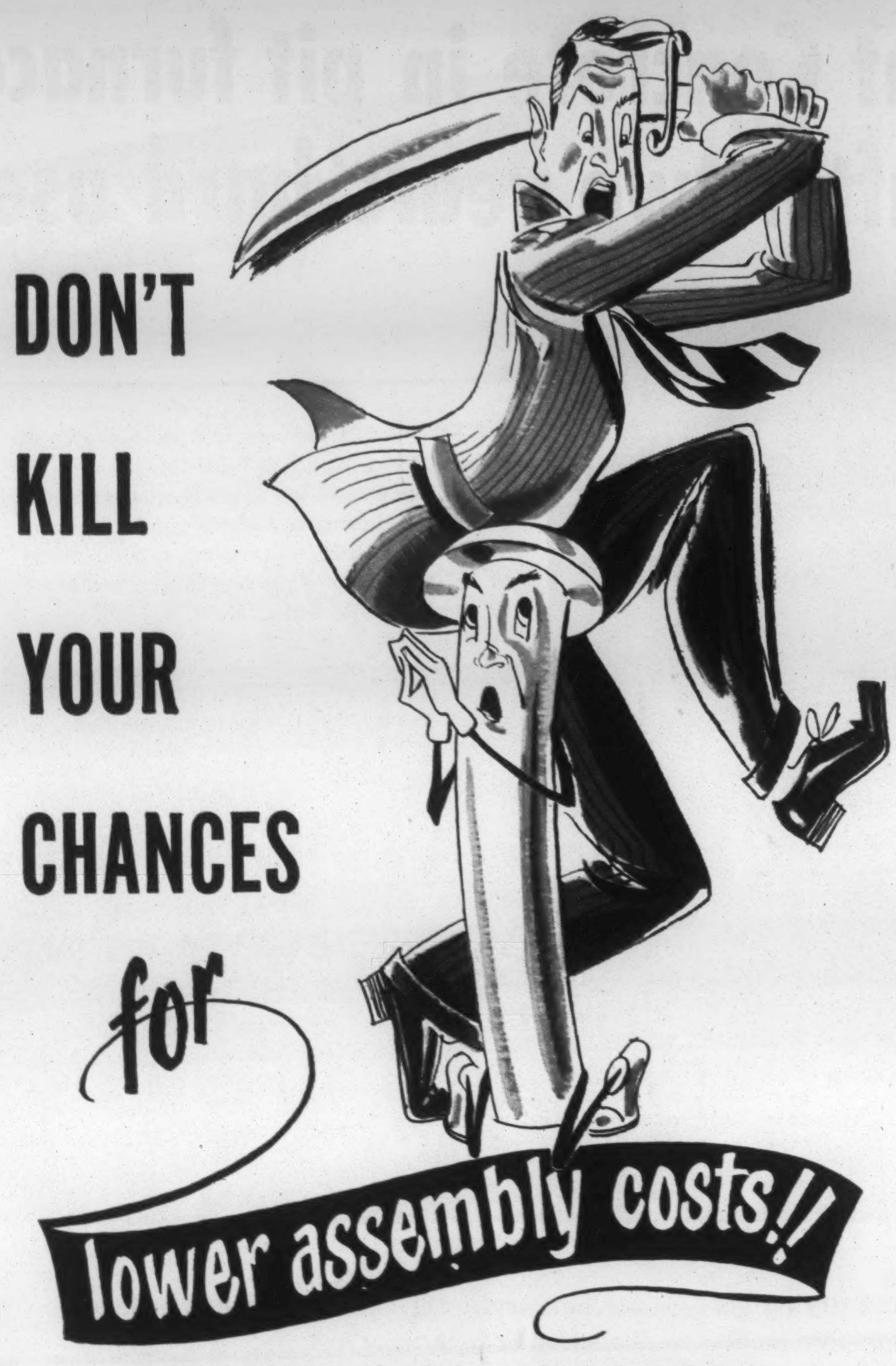

Before you tie up funds in costly tools and dies, have Milford fastener-engineers analyze your product assembly need . . . at the design stage, while plans are still flexible. It will save you money and headaches, reduce production expense, speed up assembly time, and aid you in making a better product . . . perhaps at a competitive price advantage! You can put these savings in your pocket by sending drawings and detailed description of your product fastening problem for Milford's scientific solution.

Write for your copy of the "Milford Method for solving industry's fastening problems".

EST. 1919

MILFORD

the name to rivet in your memory for fasteners

THE MILFORD RIVET & MACHINE CO.

859 Bridgeport Avenue, Milford, Conn.
834 Illinois Ave., Aurora, Ill.
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30 Platt Street, Hatboro, Penna.
721 So. Palm Ave., Alhambra, Calif.

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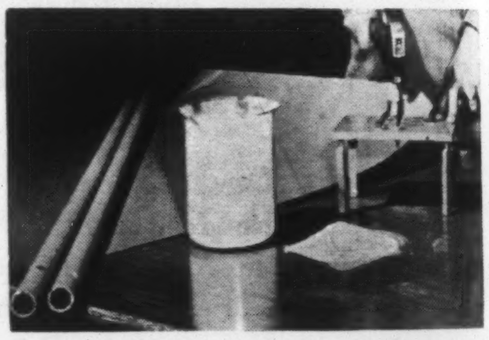
nification is accomplished during any tensile test by switching manually from one to another of the Microformers when any selected value of strain or stress is reached. A selector switch connects to the recorder outlet receptacle.

With standard optional adapters the instrument can be used on wires, flats and round specimens. Wires may be of 0.02 to 0.25 in. in dia, with gage lengths of 2, 8 or 10 in. Round specimens may be of 0.25 to 2 in. in dia with 2 in. gage length. Flat specimens may be up to 1 in. thick, 1½ in. wide and 2-, 8- or 10-in. gage length. Elongations as great as 2 in. are measurable.

The measuring unit assembly is supported by an adjustable arm which is clamped to one of the vertical columns of the testing machine. The slide frame is designed to assure straight linear movement of the Microformer and core near the pivots. The extensometer can be used with or without the arm extension on which one of the three Microformers is mounted.



New Resins Toughen Molded Plastics

Improved impact strength and toughness of molded plastic products are said to be the result of the addition of two new synthetic resins developed by *The Goodyear Tire and Rubber Co.,* Akron. Marketed under the name Plio-Tuf, the new resins are said to give products greater hardness, higher resistance to heat and better tensile strength. The manufacturer says that products molded with Plio-Tuf will resist action of acids and alkalies, and will not be damaged by a large number of staining materials. It is a white, free-flowing powder which can be made into sheets, rods or tubes by calendering or extruding; it can also be formed into complex shapes by conventional plastic molding techniques.

Plio-Tuf resins are not resin-rubber blends, the company states, but they can be plasticized with rubber to give even

A Report from Vanadium Corporation

How Vanadium Corporation's long-range expansion program is helping industry.

CHROMIUM ALLOYS

Vanadium Corporation's new plant at Graham, West Virginia, has been especially equipped to produce—by a unique new process—a remarkably clean, dense new *low carbon ferrochromium.* This new alloy combines a normal silicon content with a high chromium-to-carbon ratio which enables the steelmaker to produce stainless steels of extremely low carbon content without resorting to modification of furnace and melting practices.

The new Graham plant also produces various alloys of *ferro-chrome-silicon.* Additional modern facilities at Niagara Falls are producing increased quantities of *high-carbon ferrochromium* by Vanadium's exclusive process. There is an ever growing demand for these clean, high-density Vancoram Alloys—particularly in the many applications where quality and economy are primary considerations.

GRAINAL ALLOYS

These are the multiple-element alloys developed by Vanadium Corporation that are now being used to produce annually over *a million tons of boron steels.* Replacing critical and more costly elements with respect to hardenability and other properties, Grainal Alloys have proved invaluable not only in times of heavy defense production but also in providing low-cost, high-quality alloy steels for our peacetime economy.

New use for Grainal Alloys: alleviating the problem of hot shortness in *stainless steels.* Field reports indicate that small additions of Grainal improve the hot working characteristics of stainless, thus cutting conditioning costs and increasing output.

Anticipating the future demand for Grainal Alloys, Vanadium Corporation has included at its new plant at Cambridge, Ohio, additional facilities for their production.

VANADIUM ALLOYS

With government restrictions on the use of vanadium now lifted, steelmakers can once again take full advantage of Vancoram *ferrovanadium.* Small additions of this versatile, economical alloy often do the work of large amounts of other, more expensive alloys—*a little goes a long way.*

Vanadium Corporation has played an important role in helping to make vanadium again available in large commercial quantities.

For example . . .

New VCA mines in Colorado have substantially increased the production of *vanadium ore* in conjunction with western uranium operations.

Complete new facilities at the Cambridge, Ohio, plant will soon be in full operation to further insure a plentiful supply of highest quality ferrovanadium for every application—from watch springs to giant forgings.

More news about Vancoram Ferrovanadium: Available for many years both in bags and drums, ferrovanadium can now be furnished palletized for greater shipping economy and ease of handling.

SILICON METAL AND ALLOYS

Among the promising new non-metallic materials developed during World War II are the Silicone plastics. Their outstanding properties include resistance to both high and low temperatures—thanks to *silicon metal* used in their manufacture.

Vanadium Corporation's new Graham plant provides the plastics industry with a dependable new source of silicon metal of highest quality.

The new Graham plant is also furnishing a complete range of silicon metal and *ferrosilicon* to the aluminum, iron, steel, magnesium and other industries.

RESEARCH

Now nearing completion at the Cambridge plant is the new enlarged Research Center. This new center contains extensive, modern facilities for the further development of all Vancoram products—which also include, *titanium alloys, master aluminum alloys,* and a complete range of *foundry alloys* for every application.

VANADIUM CORPORATION OF AMERICA
420 Lexington Avenue, New York 17, N. Y.

Producers of alloys VANCORAM metals and chemicals

PITTSBURGH • CHICAGO • DETROIT • CLEVELAND
PLANTS: Niagara Falls, N. Y., Graham, W. Va.
Cambridge, Ohio

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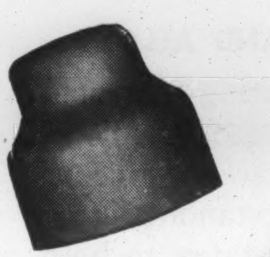
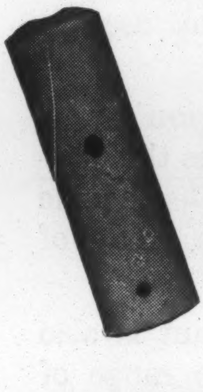

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- Extreme uniformity of size, weight, strength, capacity and wall thickness
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LINDE engineers will gladly help you with your designs, specifications and production problems involving cold-drawn shells and shapes or formed metal parts. Just mail the coupon for full information.

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COMPANY____________________

ADDRESS____________________

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greater impact strength. The properties of the resins make them suitable for molding such products as automotive parts, television screens, luggage, plastic pipe, and other items which require high impact strength.

New Dry Film Lubricant

The Everlube Co., 4435B San Fernando Rd., Glendale, Calif., has recently developed a dry film lubricant which, in addition to locking to the part, is said to have penetrative powers to diffuse into preparatory surface coatings, and in mating surfaces creates a lap-in action which assures long-life lubrication.

Green in color to aid in quality control identification, Everlube is said to have high oil retention and abrasion resistance properties and is unaffected by solvents. It can be sprayed or dipped, and, in some instances, brushed on.

Triple-Purpose Cleaning Gun

A low cost hand gun which operates on air pressure of 75 psi and up is now available for use in sand blasting, liquid cleaning or air cleaning of small parts and surfaces. The Carco gun, manufactured by *C. A. Roesch and Co.*, 1221 S. Hope St., Los Angeles, has a light, durable metal body; precision built valve and trigger assembly; and is equipped with a hardened steel jet and nozzle.

The complete kit contains the gun, three extra hardened steel nozzles, extra hardened steel jet, a glass sand container with cap, machined brass fittings, a 3-ft rubber hose and wrench for installing jet.

Some of the applications cited by the manufacturer for his product are: removing paint and carbon, cleaning welds, cleaning corroded parts, etc.

Compressed Air Dehumidifier

New developments incorporated in the Vi-Speed compressed air dehumidifier produced by *Van Products Co.*, 3761 W. 12th St., Erie, Pa., are said to increase efficiency of the unit while broadening

IS YOUR METAL PROBLEM
WEAR...
CORROSION...
FATIGUE?

℞: BERYLLIUM COPPER

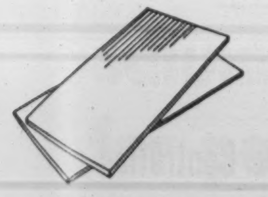
Beryllium Copper (BeCu in metallurgical shorthand) is a leader in the "resistance movement." It's uncanny the influence a few per cent of Beryllium can exert on pure copper . . . the added properties the *alloy* has over the base metal *alone*.

Beryllium Copper can be hardened by heat-treatment. It has high electrical conductivity and qualities that resist wear, corrosion and fatigue, making it ideal for switches and other electrical applications. BeCu is truly a versatile alloy, useful in many fields.

Riverside *Alloys* are Industry's *Allies*. Send for the Riverside Handbook, the pocket-size reference and guide to alloy specifications. The Riverside Metal Company, Riverside, N. J. Branches in all principal cities.

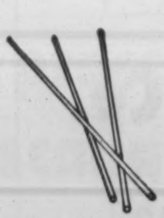
RIVERSIDE
ALLOYS

PHOSPHOR BRONZE • NICKEL SILVER
CUPRO NICKEL • BERYLLIUM COPPER

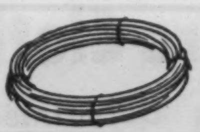


SHEET

STRIP



ROD



WIRE

Free pocket-size Alloy Handbook. Your reference and guide to Alloy specifications. Write today.

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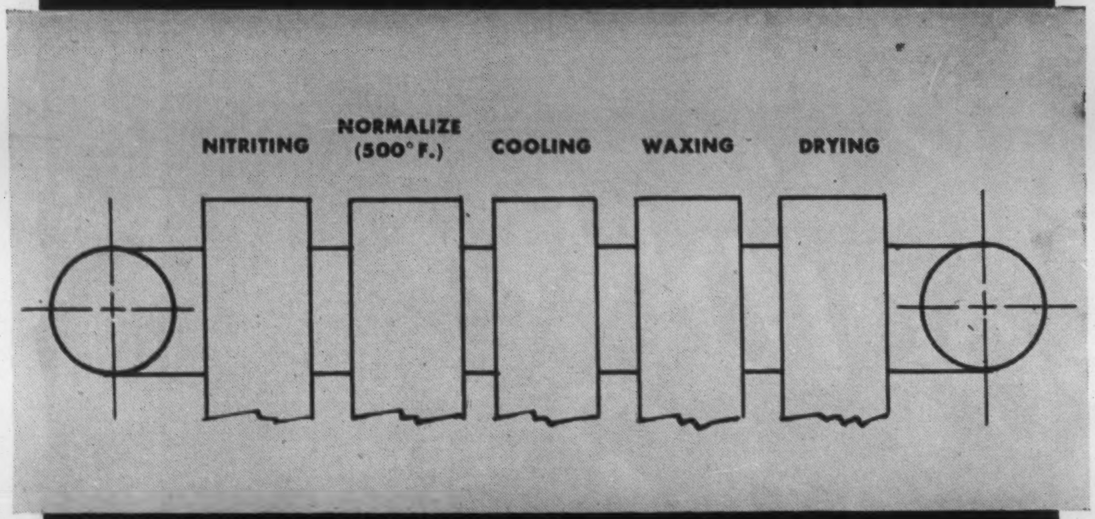
CAMBRIDGE WIRE MESH BELTS . . .



help spring producer boost output 350% in 30% less floor space!

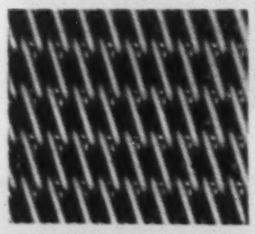
110 old-fashioned hand trucks no longer needed! 15 truck operators freed for more productive work! Floor space requirements cut by 30%. Output rose from 290,000 pieces in 24 hours to 680,000 pieces in 16 hours, *an hourly increase of 350%!*

These were the results of this installation of a 98′ Cambridge wire mesh belt in a large spring producing plant. The moving belt gives continuous production, eliminates the need for hand trucks in transferring the work from one step to the next, assures uniformly processed work.

Perhaps Cambridge wire mesh belts can help you get similar savings. They're available in any metal or alloy, mesh or weave, length or width. They can be used under practically any conditions . . . from temperatures as high as 2100° F. down to sub-zero, for handling work through simple water rinses or highly corrosive acid sprays, for carrying small delicate parts or heavy, bulky loads. All-metal belt construction assures long life and freedom from damage. Open mesh permits free drainage of process solutions or free circulation of process atmospheres.

WHY NOT CALL IN YOUR CAMBRIDGE FIELD ENGINEER?

You can rely on his experienced advice to recommend just the right type of wire mesh belt for your process. Look under "Belting-Mechanical" in your classified phone book for the Cambridge office nearest you.



Cambridge Duplex Weave, one of the most widely used specifications for continuous heat treating.

FREE BELT MANUAL tells how Cambridge belts can be used in your industry. Also includes useful data on conveyor design, metallurgical tables and belt specifications. Write for your copy today.

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CONVEYOR
BELTS

The Cambridge Wire Cloth Co.

WIRE CLOTH
METAL CONVEYOR BELTS
SPECIAL METAL FABRICATIONS

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New Materials and Equipment

the scope to cover operations under greater extremes of temperature, humidity and atmospheric pollution.

A self-adjusting nozzle, coupled with a non-clogging aspirator, is said to stabilize unit operation during variable air pressures and volumes for constant removal of injurious liquids, solids and vaporous contaminants. The baffle surfaces have been enlarged and re-positioned for greater exposure of contaminants to action of "Dryolite", the drying agent; to create a larger area for separation of heavy impurities; and for a better accommodation of momentary overloads.

"Dryolite" the self-cleaning drying agent, has been compounded to cover a greater range of line temperatures from 100 F to below freezing, widening the usability of the unit from normal building temperatures to frigid outside conditions.

New Specimen Spinner for X-Ray Diffraction

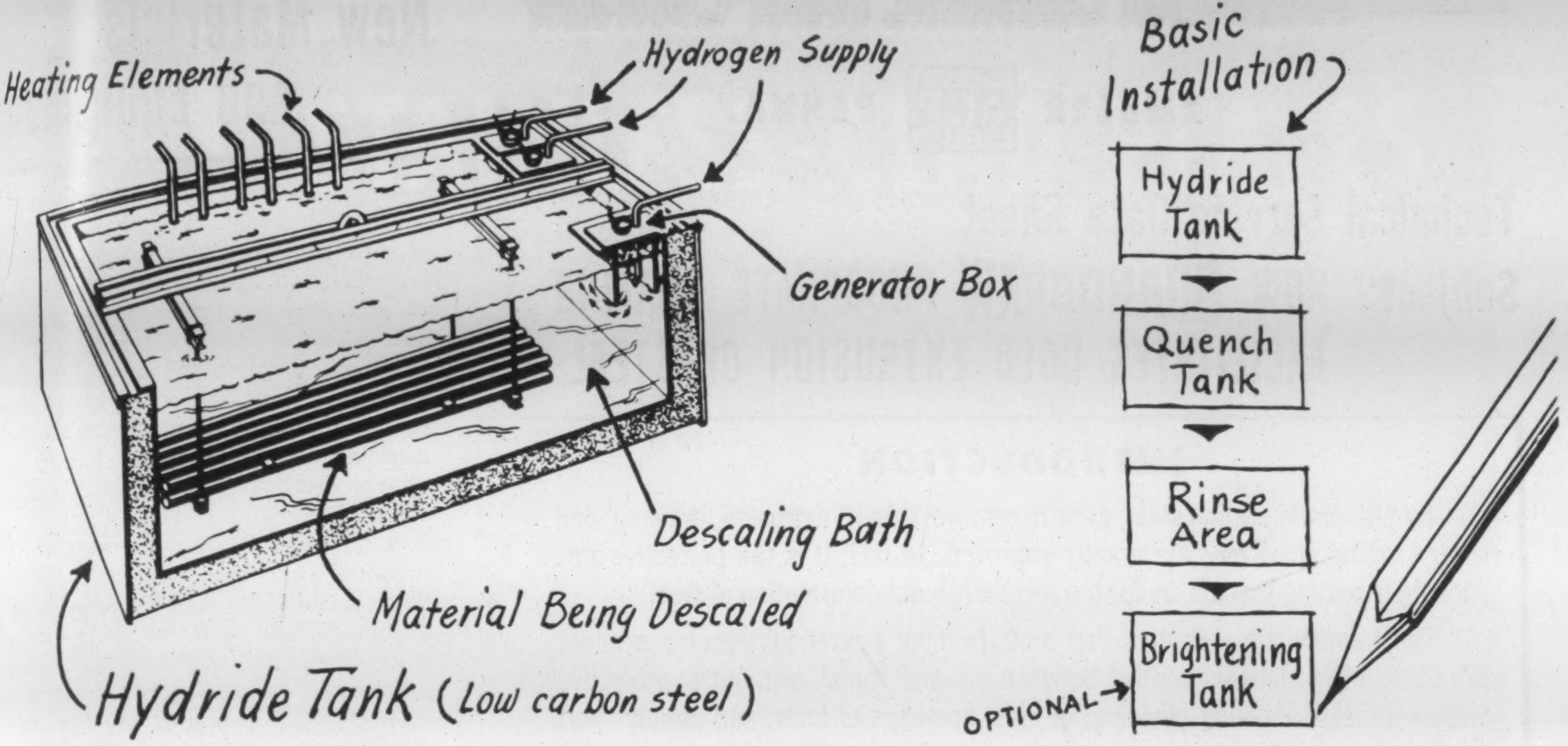
A new cylindrical specimen spinner designed for use in special X-ray analysis work has been announced by the Research & Control Instruments Div., *North American Philips Co., Inc.*, 750 S. Fulton Ave., Mt. Vernon, N. Y.

The unit has been designed to facilitate the handling of specimens of limited size and quantity where the problem involves individual analysis of small fibers or filaments, the use of sealed capillary tubes, or the coated fiber method.

The specimen holder is rotated at approximately 130 rpm by means of a precision gear assembly driven by a synchronous motor that plugs into one of the 120-v, 60-cycle, single-phase receptacles provided on the Norelco x-ray diffraction unit.

Gas Generator for Controlled Atmospheres

The *Hevi Duty Electric Co.*, Milwaukee 1, Wis., is now marketing an endothermic gas generator which is said to



Designed for simplicity of operation

DU PONT SODIUM HYDRIDE DESCALING PROCESS

The Du Pont Sodium Hydride Descaling Process uses simple, compact, low-cost equipment, and is so easy to operate that any pickler can be trained to run it effectively—within hours. Yet this remarkably efficient process is the fastest, most thorough descaling process in operation today! Just *one* treatment—including 15 seconds to 20 minutes in the hydride bath—is all it takes to completely clean a large volume and variety of work. And there is positively *no* danger of base metal attack—even if work is left unattended in the hydride bath *after* the descaling action is completed.

INVESTIGATE THIS MODERN METHOD OF DESCALING—You will probably find that you can improve your present descaling operations in many significant ways—and cut costs besides! Not only can you save the base metal that is pitted or etched away by other pickling methods, but your over-all cleaning procedure may be simplified. For example, sodium hydride descaling eliminates the need for any scale softening or breaking operations. By doing away with this step alone, there is a sizable saving in time, manpower and valuable floor space.

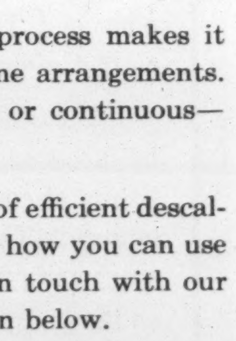
The flexibility of the sodium hydride process makes it adaptable to varied shop or production-line arrangements. Equipment can be manual, conveyorized or continuous—designed to meet your requirements.

GET THE FACTS FROM DU PONT—the pioneer of efficient descaling with sodium hydride. Let us show you how you can use the Du Pont process *profitably*. Just get in touch with our nearest district office or send in the coupon below.

DISTRICT AND SALES OFFICES: Baltimore • Boston • Charlotte • Chicago Cincinnati • Cleveland • Detroit • Kansas City* • Los Angeles • New York Philadelphia • Pittsburgh • San Francisco.

*Barada & Page, Inc.

More detailed information about the process—how it works, what it can do for you—can be found in our new book. Call our nearest office or use the coupon below for your copy.



E. I. du Pont de Nemours & Co. (Inc.)
Electrochemicals Department MM-103
Wilmington 98, Delaware

Please send me more information about the Du Pont Sodium Hydride Descaling Process: advantages, applications, equipment used. I am interested in descaling______

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DU PONT

Sodium hydride process for positive descaling

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BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

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AMERICAN CHEMICAL PAINT COMPANY

AMBLER CHEMICALS ACP PROCESSES **PENNA.**

Technical Service Data Sheet

Subject: HOW GRANODRAW PHOSPHATE COATING FACILITATES COLD EXTRUSION OF STEEL

INTRODUCTION

By phosphate coating steel, prior to cold working it, extrusion, drawing, and other forming operations are greatly improved. In fact, it is the protective zinc phosphate coating that makes for the successful cold deformation of steel.

The tremendous pressures that most forming operations require produce extremely high frictional contact between die and metal. Without a protective coating, excessive galling (welding) of dies, breakage of tools, and unduly short die life will result. The combination of a non-metallic crystalline phosphate coating with an adsorbed lubricating film, possesses a low coefficient of friction while maintaining its stability under extremely high deforming pressures. This combination, therefore, greatly minimizes the aforementioned tool difficulties.

THE COLD EXTRUSION OF GENERATOR FRAMES

Cold extrusion is now being used advantageously in the manufacture of high production generator frames. This operation is facilitated by careful preparation and proper coating of the frame blank which is made from SAE 1010 open hearth plate steel.

After wheelabrating to remove the scale, the blank is rolled up and then fed automatically through a six stage dip wheel type washing machine which cleans the surface and applies the coating. The frame is then fed into an extrusion press where the wall thickness is increased on one end and reduced 47.5 percent on the other end. This operation produces concentric frames of uniform thickness and correct dimensions.

The Granodraw coating produces the proper surface to receive the lubricant by furnishing an extremely adherent film with the proper crystal size and continuity of coating required to insure maximum adsorbsion and tenacity by the lubricant. The lubricant, Montgomery DF 1101, is a combination of titre alkali soaps and resins. It is a powder which when dissolved in water and redeposited on the phosphate coated work piece, produces the necessary surface for subsequent operations. This film is dry and considerably less hydroscopic than similar coatings of the soap type. The concentrations of both the Granodraw and DF 1101 are maintained by simple chemical analysis.

PROTECTIVE COATING SEQUENCE

Stage	Operation	Chemical	Time	Temperature
1	Load and unload			
2	Cleaning	Tri-sodium phosphate and soda ash	1 Min.	180° F
3	Water rinse		1 Min.	180° F
4	Zinc phosphate coating	"Granodraw"*	4½ Min.	165° F to 180° F
5	Water rinse		2 Min.	180° F
6	Lubricating	H.A. Montgomery lubricant DF 1101	4½ Min.	190° F

*Trade Mark of the American Chemical Paint Company

CHEMICALS ACP PROCESSES

For more information, turn to Reader Service Card, Circle No. 425

New Materials and Equipment

produce controlled atmosphere of consistent chemical analysis for various types of heat treating operations. Among these operations are bright hardening of molybdenum, tungsten and cobalt high-speed steel; annealing and normalizing; bright copper brazing, carburizing and carbonitriding; and sintering and powder metallurgy processes that require a reducing atmosphere.

According to the manufacturer, the generator has been designed for economical, safe, and simple operation. It is a package unit with air filter, air gas mixing machine, gas cracking chamber, gas cooler, control panel, and power transformer all mounted on a structural steel base.

The unit is available in three sizes: 300, 500 and 750 cu ft per hr.

Ion-Resonance Mass Spectrometer

A new mass spectrometer designed specifically to meet process instrumentation requirements in the gas, petroleum, pharmaceutical and chemical fields has been developed by *General Electric Co.'s Special Products Section.*

The new instrument uses the most recent development in mass spectrometry, the principle of ion resonance. In addition, a sample inlet system has been designed to allow direct connection to a stream or process line, thus allowing continuous sample introduction. Operation covers an approximate range of 1 to 100 mass units.

Incorporated into the new G-E equipment is a programming device which allows automatic and repetitive continuous scanning of the spectrum, manual scanning or selection of peak or peaks of a given mass, and, with minor modification, automatic monitoring of one or more peaks in sequence.

In this unit, the ions are actually formed within the magnetic field instead of a separate ion chamber. Ions of a specific mass are caused to follow a spiral path to a collector by applying a superimposed, radio-frequency, electrostatic field. By controlling the frequency, only ions of a definite mass-to-charge ratio are caused to follow the spiral path while all others are drawn out of the analyzing region. Thus the signal received by the collector is indicative of the quantity and mass of the ions present. As the frequency is varied, the complete spectrum is observed.

Components

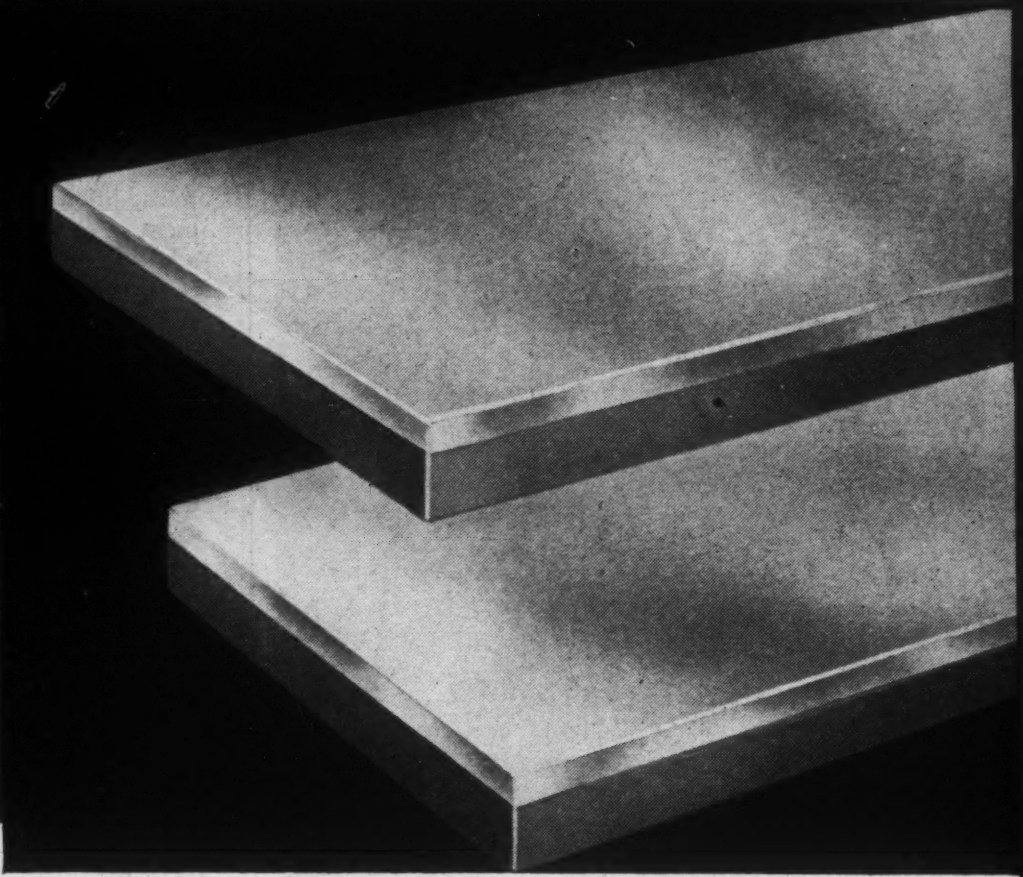
The spectrometer employs an analyzer tube which utilizes the resonance phe-

(Continued on page 222)

For more information, Circle No. 521

CF&I

STAINLESS-CLAD PLATES



stainless steel advantages

. . . with carbon steel strength

. . . at lower cost

If you use stainless steel in your fabrication or construction, chances are you can lower your material costs substantially by means of Claymont Stainless-Clad Plates.

In numerous and diversified applications, these plates are giving all the advantages of stainless steel, including prolonged resistance to the corrosive action of acids and alkalis.

Claymont Stainless-Clad Plates are a composite of stainless steel permanently bonded to a carbon steel backing. Easy to fabricate, they will not buckle, crack or peel under the severest forming operations. To order, write or call Claymont Steel Products Department, Wickwire Spencer Steel Division, Claymont, Delaware.

THE COLORADO FUEL AND IRON CORPORATION—Denver, Colorado
PACIFIC COAST DIVISION—Oakland, California
WICKWIRE SPENCER STEEL DIVISION—Atlanta • Boston • Buffalo • Chicago • Detroit
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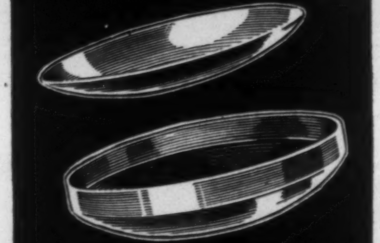
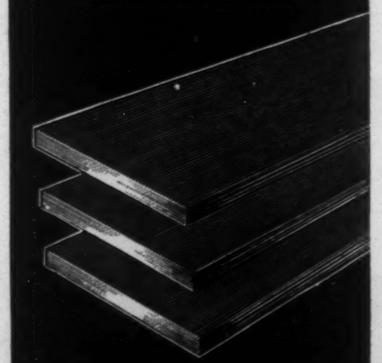
CANADIAN OFFICES: Toronto • Winnipeg • Edmonton • Vancouver



Flanged and Dished Heads



Carbon and Alloy Steel Plates

Large diameter steel pipe

CLAYMONT STEEL PRODUCTS

WICKWIRE SPENCER STEEL DIVISION
THE COLORADO FUEL AND IRON CORPORATION
CF&I

1280

For more information, turn to Reader Service Card, Circle No. 491

HOW HEAT
(UP TO 2200° F)
CAN BE STOPPED COLD

Destructive effects of extremely high temperature can be minimized—by using Kentanium at the critical points.

WHAT is Kentanium?	Chiefly titanium carbide (and small percentages of other refractory metal carbides), with nickel "binder". Uses neither tungsten nor cobalt. Hardness: Up to 93 RA. Weight: ⅔ that of steel.
WHAT can it do?	Resist thermal shock, withstand oxidation and abrasion, retain great strength at high temperatures (1800°F and above).
WHERE is it in use?	Successful applications include: Valves, valve seats, reduction crucibles, anvils for spot welding, hot extrusion die inserts, bushings, thermocouple protection tubes, flame tubes, furnace tong tips, balls for hot hardness testing, nozzle vanes and blades for jet engines, and many others.
WHAT forms are made?	Tubes, rods, bars, flats by extrusion process. More complex parts by machining from pressed slugs before sintering, extremely accurate parts by grinding to required tolerance after furnace sintering.
HOW can you use it?	This remarkable new metal, available in many "grades" to meet specific combinations of imposed conditions, can best be adapted to your high temperature problem by cooperative effort. Our engineers will be glad to discuss how you can get best results from Kentanium.

An Exclusive Development of KENNAMETAL® Inc., Latrobe, Pa.

KENTANIUM
HEAT-RESISTANT, HIGH-STRENGTH, LIGHTWEIGHT
CEMENTED TITANIUM CARBIDE

See Kentanium demonstration — National Metal Exposition, Cleveland — Space 311

nomena to separate ions of differing mass units, a permanent magnet to produce the required steady magnetic field, and a radio-frequency oscillator to provide the necessary field for resonating the ions. The output of the instrument can be read directly on a large meter located on the control panel or can be supplied to additional external recording equipment. Provision is made to allow the addition of a recorder, an automatic computer, or process control circuitry.

The unit consists of a single 750 lb cabinet, approximately 24 in. wide, 30 in. deep, and 47 in. high. Power requirement is 115 v, 15 amps, 60 cycle phase. A diffusion pump incorporated in the equipment requires 2 to 5 gal per hr of water for cooling, and the cabinet is provided with a blower which supplies 200 cu ft of air per min for maintaining the proper operating temperature.

New Metallizing Machine

The Vandersee Engineering Co., Inc., 727 W. 7th St., Los Angeles, has marketed a new metallizing machine with a nozzle which is said to eliminate the need for manual adjustment by the operator and assure an even flow of metal to the surface being metallized.

The bearings for the wire feed mechanism are encased in the main body gear case casting, insuring gear alignment, and the gas mixing chamber is built into the nozzle at the point of combustion, eliminating backfire.

The manufacturer says the new machine is lightweight, compact, easy to operate and is designed to be trouble-free.

New Nickel Plating Process

A new bright-nickel process has been developed by *Hanson-Van Winkle-Munning Co.*, Matawan, N.J., which is said to be cheaper and easier to control than other commercial bright-nickel processes.

Equipment suitable for a Watts nickel bath is required and ordinary auxiliary equipment may be used. Filtration may be either periodic or continuous; ventilation is not required and heat demands are said to be 25% lower.

The company claims that the Nickel-Lume process produces deposits which approach the whiteness of cobalt-nickel deposits, well-leveled surfaces, low in-

←For more information, Circle No. 483

New Materials and Equipment

ternal stress, good ductility, and highly active surfaces. The baths may be operated from room temperatures up to or beyond 140 F with full deposit brightness. Current densities may be varied from 5 to over 70 amps per sq ft.

In production tests, Nickel-Lume is cited as overcoming the following limitations of present organic-type nickel processes:

1.—No batch purification treatment is needed under good operating conditions since the addition agent in the process does not break down into harmful products.

2.—Thin deposits are bright.

3.—Surface preparation is held to a minimum.

4.—The process uses regular non-premium nickel anodes.

Nonmetallic Rust Inhibitor

A new rust inhibiting oil additive for the protection of ferrous surfaces is now available in commercial quantities from *Atlas Powder Co.,* Wilmington, Del. Identified as Atpet 100, the new inhibitor is a sorbitan mono fatty acid ester somewhat similar to the Atlas Co.'s Span 80, though said to be a substantial improvement.

In internal combustion engines, Atpet 100 is said to provide freedom from pre-ignition and other undesirable effects of ashy residue encountered with sulfonic inhibitors containing the salts of such metals as sodium, calcium or barium.

The company states that laboratory tests show considerably improved and uniform protection over other earlier inhibitors. In a standard humidity cabinet test, it has withstood 634 hr of exposure at 1% concentration in oil, nearly double that obtainable with earlier inhibitors.

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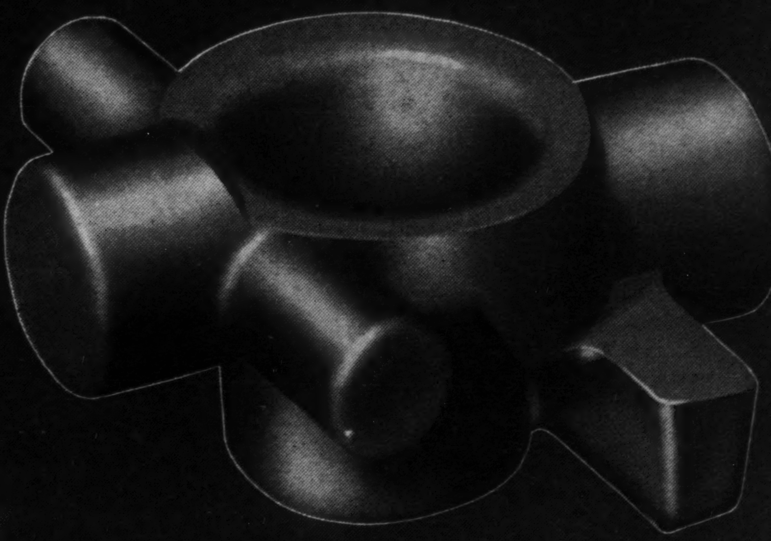

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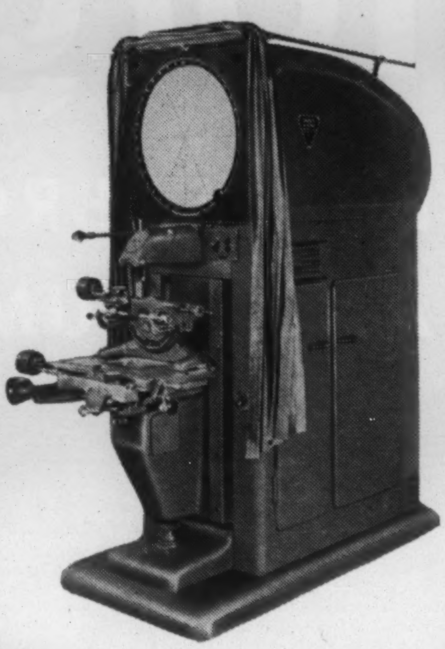

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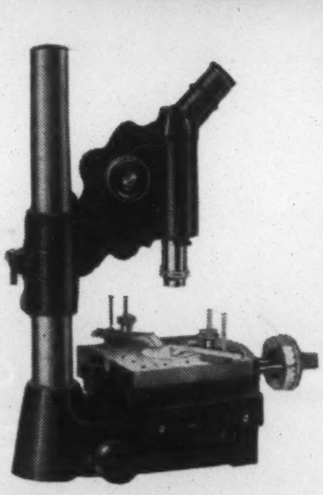

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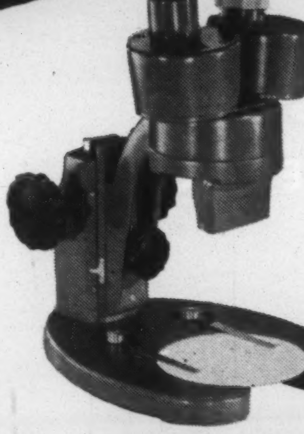

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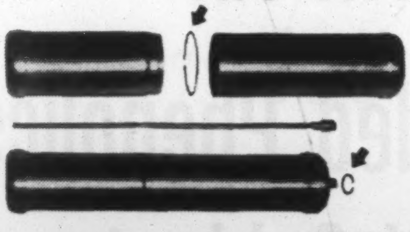

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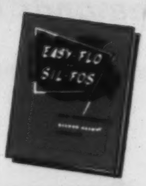

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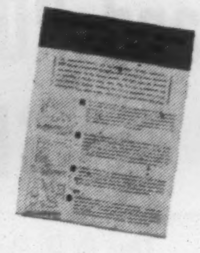

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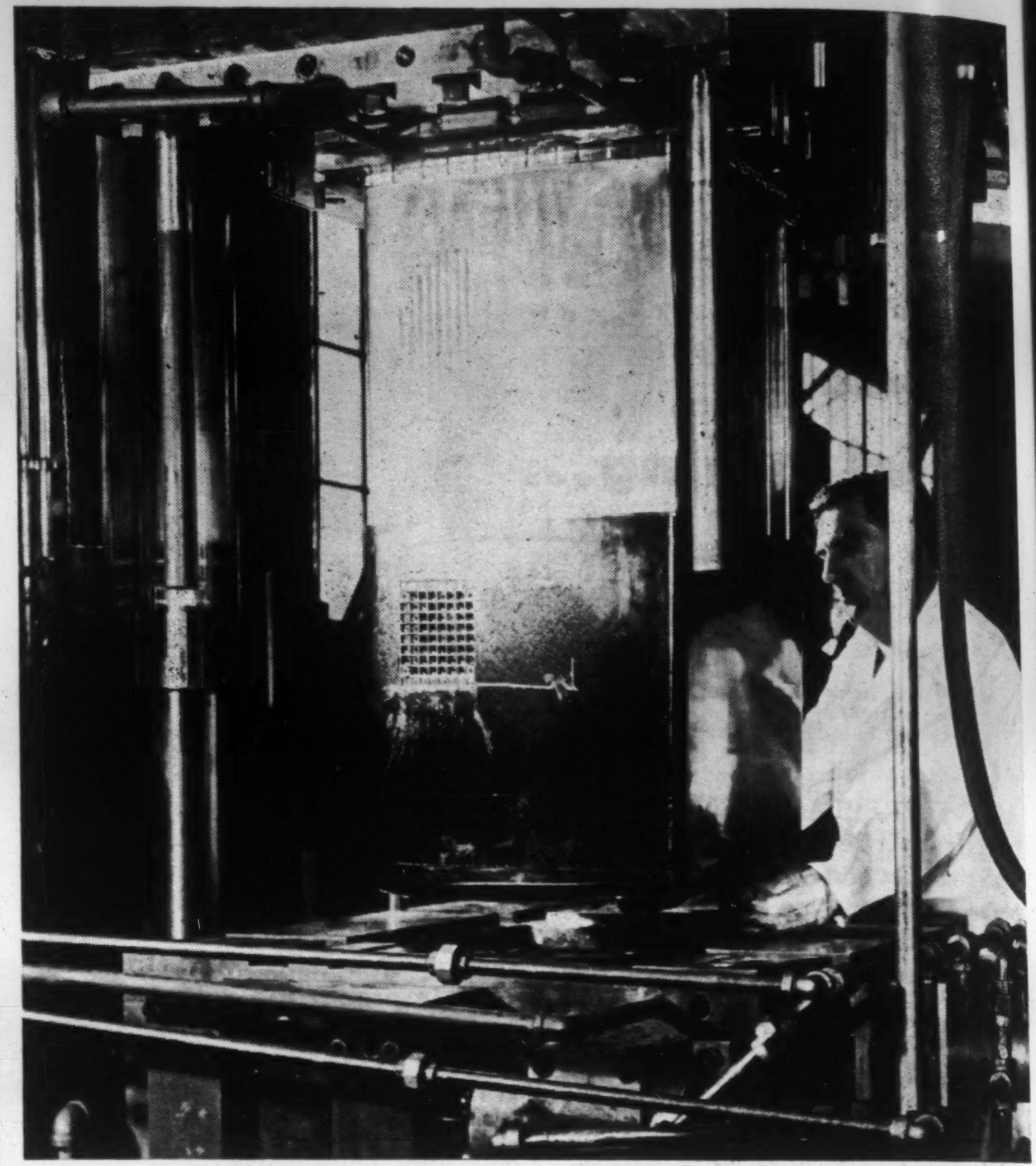

A cabinet molding being removed at the end of the mold cycle.

Compression Molded Phenolics Used for Large TV Cabinets

by **KENNETH ROSE**, Mid-Western Editor, Materials & Methods

Plastic moldings are steadily increasing in size to meet the demands of industry. For TV cabinets, they have proved to be competitive with steel and wood.

• THE USE OF compression molding for plastics is limited to pieces of relatively small size by the practical considerations of force to be exerted by the press, and the size of molds and other parts needed to contain the piece and resist molding pressure. However, with the ever increasing knowledge of plastic materials and their properties, the demands of industry have made necessary a steady increase in the size of such molded pieces.

The most recent challenge to compression molders has been that of the cabinets for two models of a 21 in. Motorola television receiver. The two moldings are among the largest one-piece moldings ever produced in phenolics, requiring a charge of 29½ lb of material for each cabinet. The company decided to utilize plastic moldings in these receivers for

(Continued on page 228)

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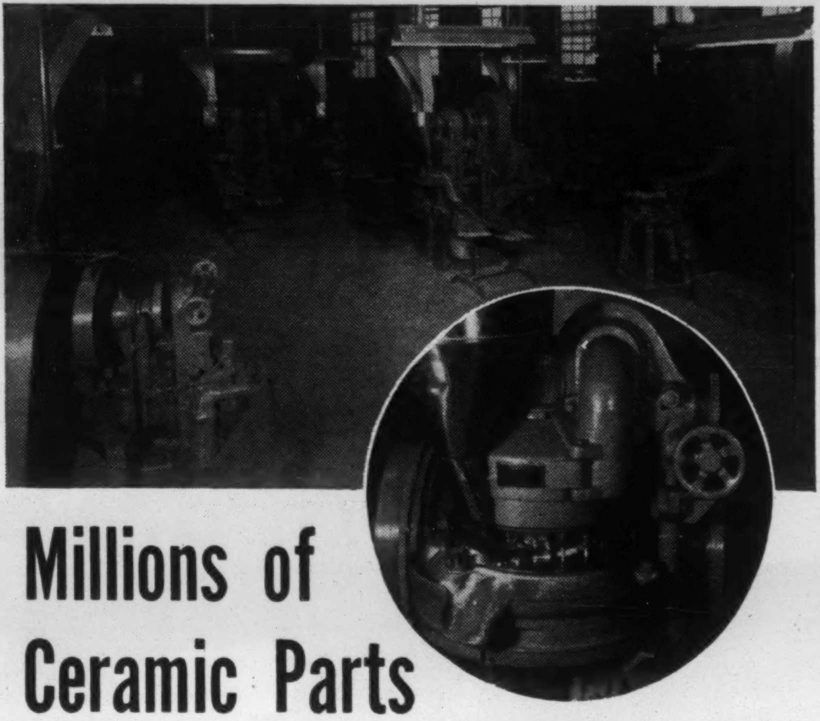

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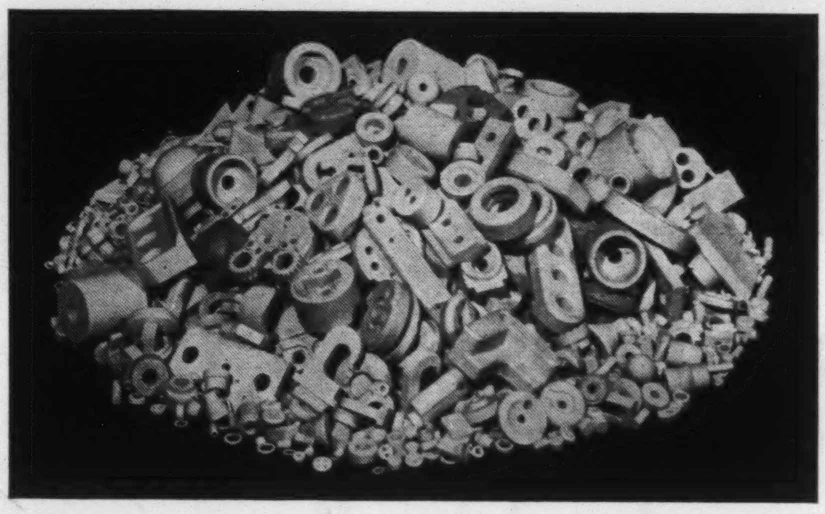

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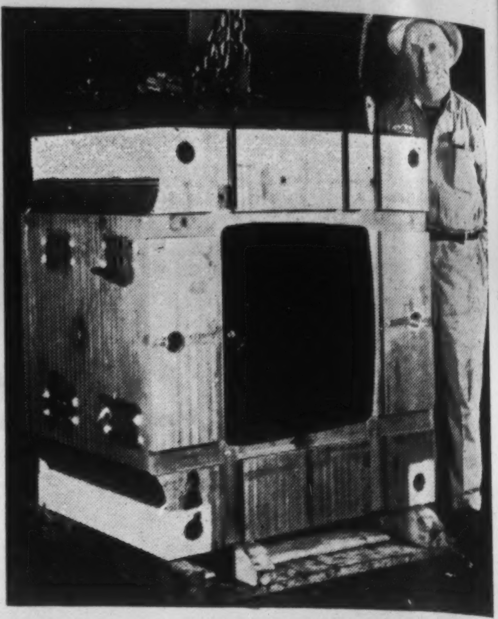
Compression Molded Phenolics...

continued from page 226



One-piece mold cavity block made of special analysis chromium molybdenum steel for molding cabinets.

several reasons: inherent beauty of the material, electrical insulation properties, durability under rough use, strength of the thick-section molding, and moisture and warp resistance of the phenolic material.

Special Molds Used

For the steel molds, designed completely by the engineers of Chicago Molded Products Corp. for use on their heavy presses, a special analysis chromium molybdenum alloy called CSM2 Plastic Mold Steel, produced by Crucible Steel Co. of America was chosen because of its consistently high quality and its ability to take on a high finish. The molded plastic piece receives its finish from the finish of the mold, and any irregularity or defect in the working surface will be reproduced on every piece formed in the mold.

The mold cavity block required a forging weighing approximately 13,900 lb, with rough machined dimensions of 40 by 28 by 43 in. Machining down of the original cast ingot to readiness for final polishing reduced the weight of the piece to about 10,500 lb. In addition to the mold cavity, the plunger which forms the male portion of the mold set was produced of similar material. Cavity and plunger together weighed about 18,000 lb, which is probably the largest single mold ever used for compression molding of plastics.

There are two of these molds, both placed on the 130 ton press at the same time for high production of the TV cabinets. A grill in one side of the cabinet is molded in place by using retractible steel cores,

(Continued on page 230)

elastic stop nuts solve all ten types of problems

Here are ten typical fastening problems. One device, the ELASTIC STOP nut, solves them all—without additional parts or operations. Deliberately undersized in relation to bolt diameter, the red elastic collar grips the bolt with a perfect fit, exerting a continuing self-locking pressure against the threads, and holding the nut securely in place at any point on the bolt. It also provides a tight seal against the bolt threads, which prevents seepage and wear-producing axial play. And because the bolt threads are protected against moisture from without, the nuts are not "frozen" to the bolt by corrosion.

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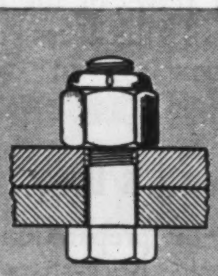

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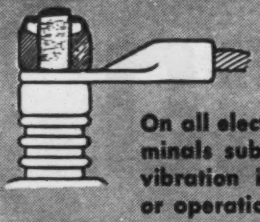
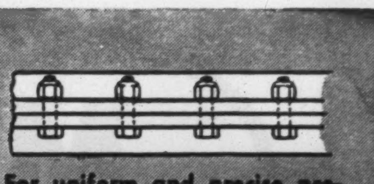


On all electrical terminals subjected to vibration in transit or operation.



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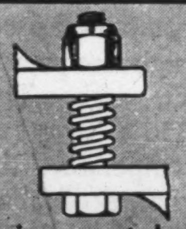
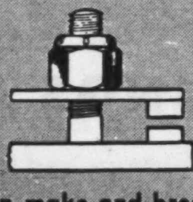


Spring-mounted connections or dynamic balancing, where nut must stay put yet be easily adjusted.



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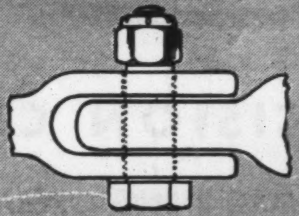
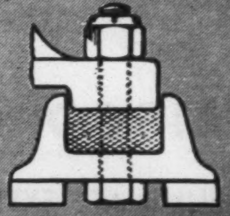


For bolted connections requiring predetermined play.



For rubber-insulated and cushion mountings where the nut must not work up or down.

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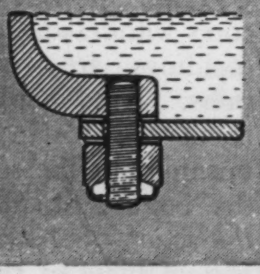
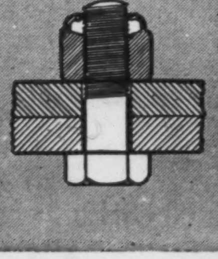
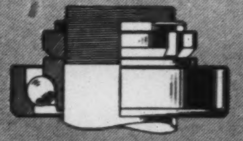


To seal bolt threads where elimination of leakage past stud threads is necessary.



To seal bolt threads where it is necessary to protect them from corroding elements.



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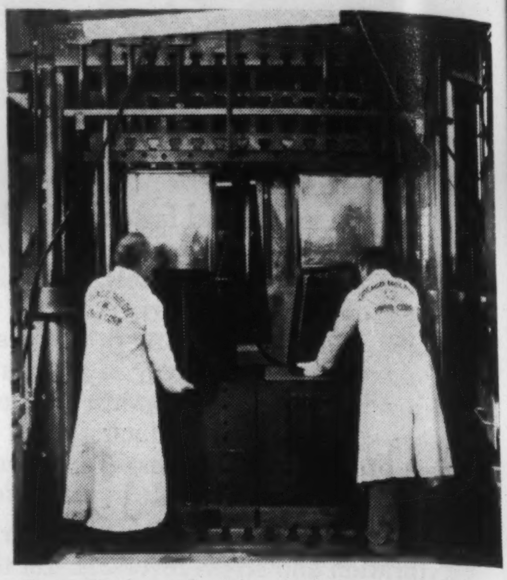
continued from page 226



Two 21 in. television cabinets are molded in each cycle.

withdrawn at right angles to the line of travel of the mold plunger. The wall thickness of the cabinet is about 1/4 in. with some sections slightly heavier.

How It's Done

In preparation for the molding cycle, brick-shaped preforms of the wood flour filled phenolic molding compound used, are preheated in two high frequency heating units of 15 kw each. The mold is heated to 350 F by steam, and is held at that temperature throughout the run. A charge of about 22 preforms totalling about 29½ lb, is placed in each mold cavity, making the charge 59 lb per cycle. The plungers move down to close the molds, and full pressure is applied. When the plungers are raised and the retractible cores withdrawn, the finished cabinet moldings are removed from the press. The complete cycle requires about 3 min. In each cabinet, the opening for the screen is formed at the bottom of the mold cavity by the action of the plunger against the bottom plate of the mold. A small amount of flash around the top of the molded piece is removed by the pressman with a file.

Only one machining operation is required to finish the cabinet. A pattern of ventilating holes and screw holes for attaching the chassis are drilled in the bottom of the cabinet with a multiple-spindle drill press.

The investment in molds makes the initial cost of the molded television cabinet high, but quality of the product and the quantity production possible make it competitive with steel or wood cabinets.

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Shown at the right in actual size is one of the many cold forged parts being produced by Allied.

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If you have need for parts similar to these . . . if you require tolerances as close as may be required for most machined parts . . . if you want maximum strength and durability in the parts produced . . . it will pay you to investigate what Allied can do for you. Send your part prints for quotation.

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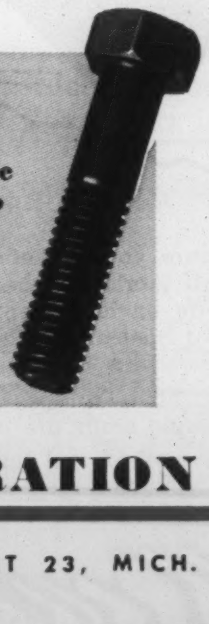

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News Digest

Metals Market . . .

continued from page 6

the first time since the major 1952 strike, but the 88.7% capacity operation was mostly attributable to one major mill strike, the labor day holiday and the remarkable heat wave that immortalized the week before labor day.

The general picture for steel looks better from the buyer's standpoint than it has in a long time. There is less panic buying, the inventory situation is normalizing, and buyers are getting more and more leeway to give orders a lot of consideration and make sure they get exactly what they want.

While 1953 steel production may not top 1951 records by much if it tops them at all after last half year production figures are in, it will be a record year for delivering the kind of steel that buyers want directly from mill sources.

Copper

Copper is in adequate supply. Most buyers seem to feel that the price is too high and that a combination of pressures will cause it to drop. Copper suppliers, of course, don't share the view of the buyers and are loath to give in to the resistance. Most of the eyes in the copper industry are on the international situation, where there has been more action than is reflected in the price picture of the last few months.

The English Government got out of the copper business to some extent by putting it back into the private hands of the free market, but kept a motherly watch over the price by sitting tight on its immense stockpile. Few buyers rushed in when the price failed to decline as expected.

Despite Chile's tentative overtures and false starts toward selling her 65,000 ton surplus to iron curtain countries, the U. S. Government refused to bite at the 35½¢ price tag that Chile put on her surplus copper as the minimum cost for getting her production back to world market prices. Slow bargaining finally convinced the Chilean government that it would have to sell at world prices, but as the U. S. prepared to buy the Chilean metal for stockpiling, a hue and cry arose from the domestic industry calling for government pur-

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This hydraulic press valve was formerly made as a steel forging. Changing to a malleable iron casting with all holes cored, drilling and counter boring were eliminated resulting in a saving of 80% in machining costs and 25% in weight.

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chase of U. S. surpluses, too.

By and large, it appears that there is more copper being produced than is needed, and copper prices face some serious depressing influences. Even with Chilean production off the market, there has been more than enough copper from U. S. and European users from domestic sources and from sharply increased imports from Rhodesia, Belgian Congo, Yugoslavia, Canada, Turkey and Australia. Adding Chile's 35,000 tons per month could easily speed a price decline. From the long range view, smart buyers will get what they need for the present from inventories and small purchases and wait for cheaper metal for future use.

Aluminum

Conflicting announcements from government agencies clouded the aluminum picture early in the fall, particularly an ODM bulletin simultaneously announcing that the government would take a record amount of aluminum for stockpiling and that more would be available for civilian use. Hoots from the aluminum producers brought a government hedge that more would be available for civilian use *if* there were no water shortage in the Northwest. A ten percent reduction in aluminum orders for armament in the fourth quarter will be offset by the increased stockpiling, so supply of the light metal is not expected to improve in the immediate future.

Nickel

The last of the major metals to be removed from government allocation, nickel will be in short supply almost indefinitely. Mills reported 18:8 stainless steel bars were building up in inventory due to end use restrictions, but that was the only surplus in sight. The automobile industry has been anxiously awaiting decontrol and relaxation of requirements limiting the underlayer in chromium plating. But no matter how you slice the nickel pie, there won't be enough to go around for everyone. Even with a stretchout of aircraft production and stockpiling, a lot of users will not be able to get the nickel they want.

One bright spot in the nickel supply situation is a new government contract with Inco of Canada calling for additional deliveries of 120 million pounds of nickel over the next

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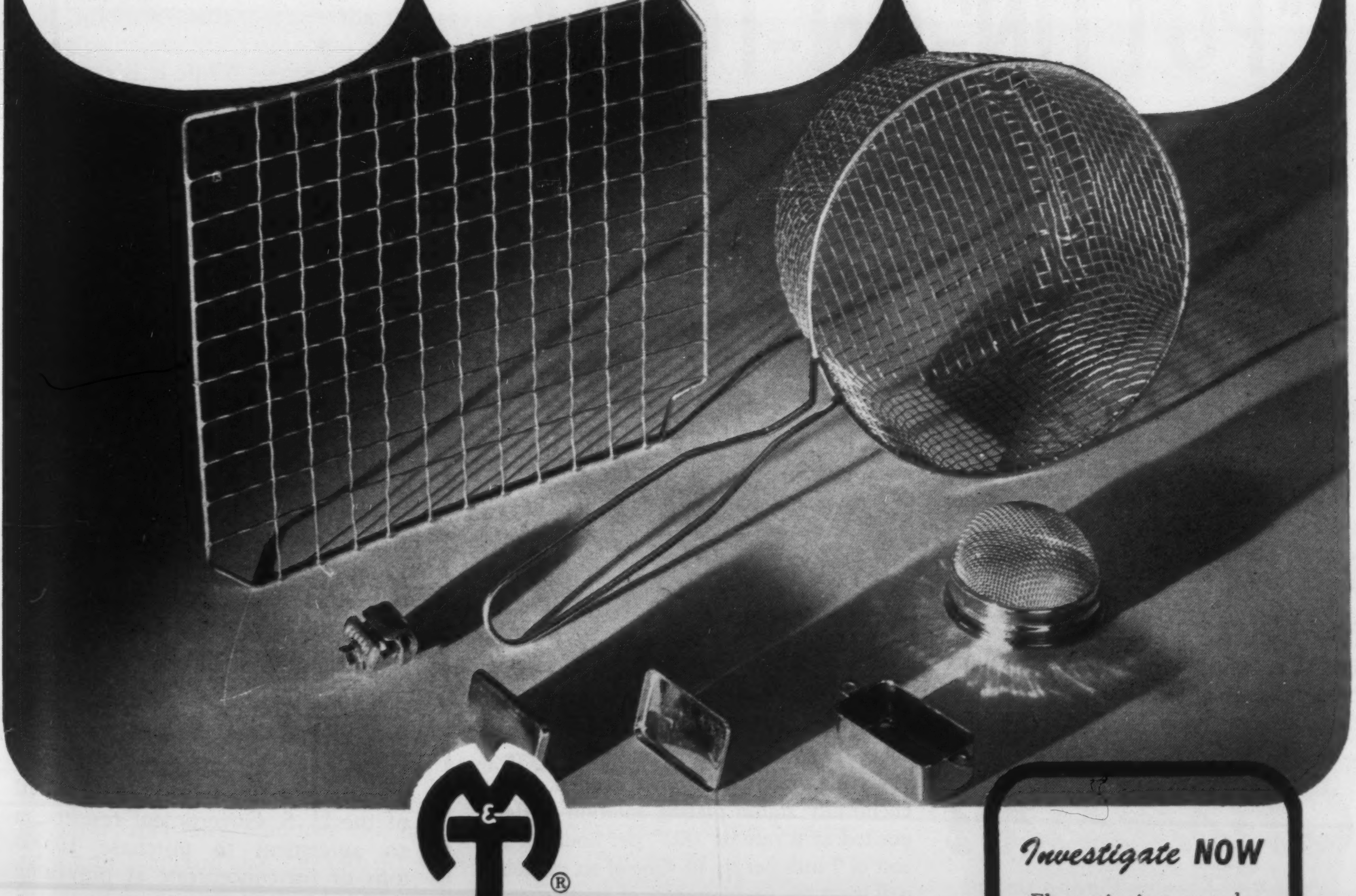

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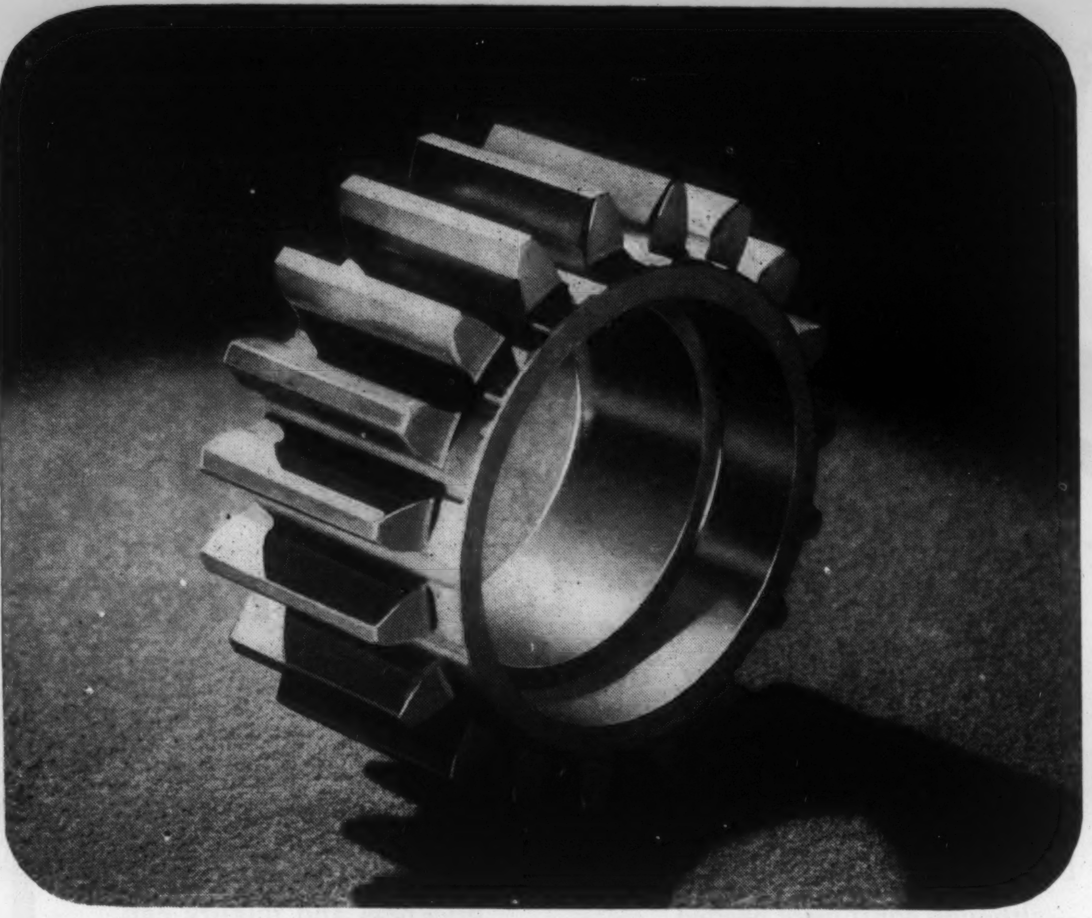

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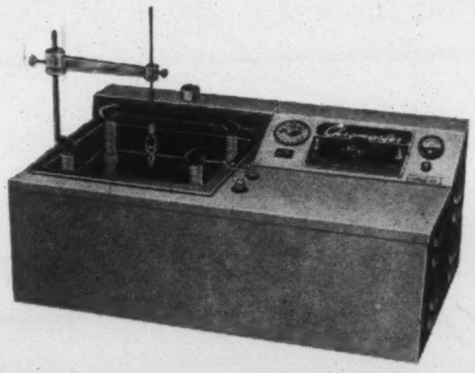

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For more information, turn to Reader Service Card, Circle No. 527

News Digest

five years from recently completed new facilities in the Sudbury District. The ODM predicted cautiously, "with this new contract we can begin to look forward to the time when there will be enough nickel to meet all demands". Nickel short industry can only wonder when.

Tin

The tin supply picture is somewhat clouded by the inevitable international politicing that surrounds the market of the imported metal. Some reliable trends are emerging, however. The general decline in tin prices from a March high of $1.21 to a rather steady 81¢ does not show many signs of climbing back to the scare level prices.

The Malayan Tin Bureau warns that the Malay states economy is approaching a crisis due to reduced income from the depressed tin prices. It advises, too, that "wasteful" mining procedures are endangering future reserves. While it is regrettable that the low tin price is resulting in the unemployment of some Malay miners, the fact is that a more realistic price for tin makes it unprofitable to operate a lot of marginal, low grade, inefficient mines, and there is little justification in keeping them going during periods of normal demand at the expense of inflated world prices.

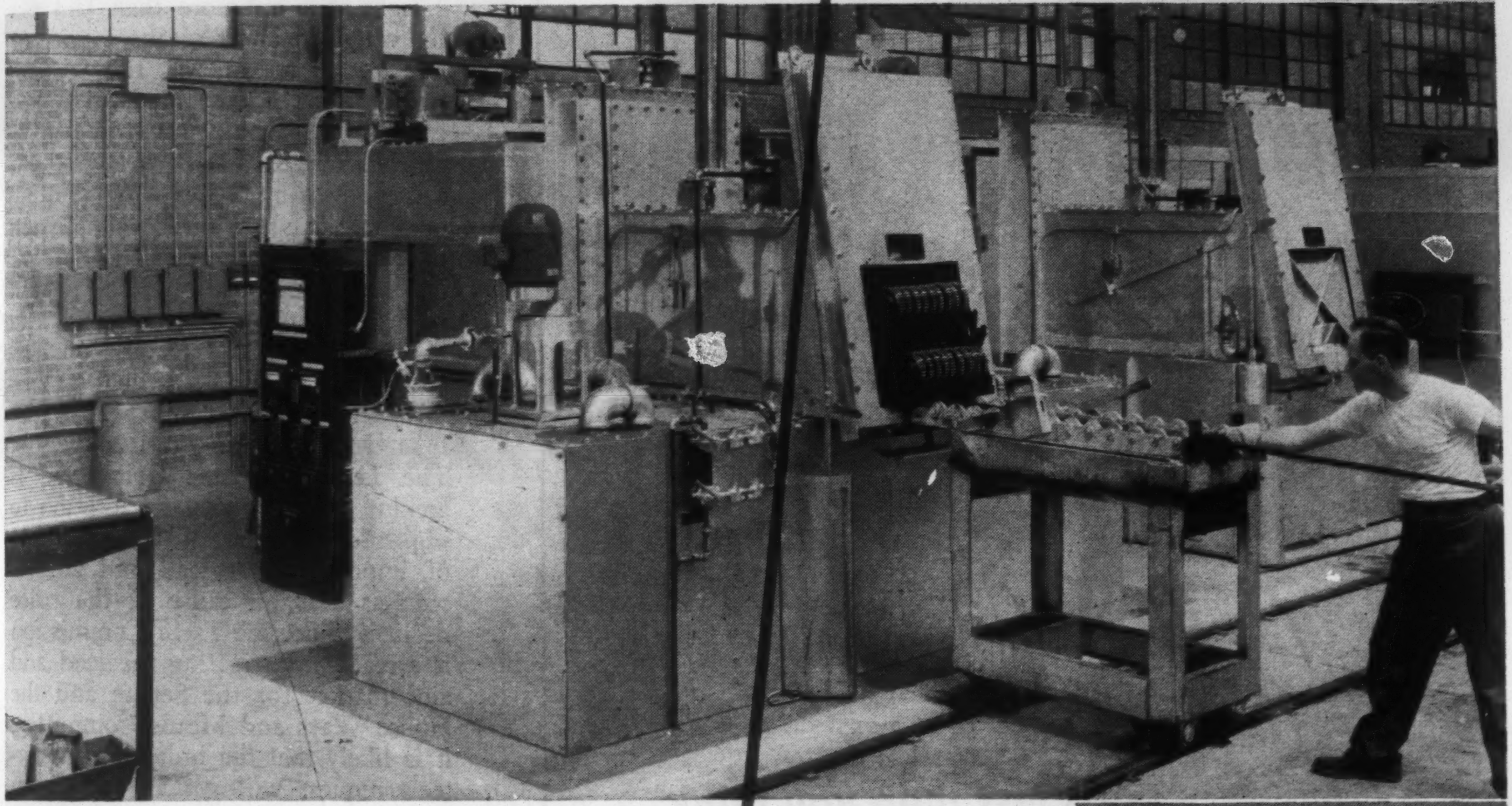
The United States Government has temporarily scotched plans for an international tin agreement which many tin producers had hoped would fix the world price of tin at an arbitrary level. The United States did not turn down the international group permanently, but begged off with the excuse that no discussions could be held until foreign policy decisions were made later in the year. Without the world's largest and most important customer, an international agreement would be meaningless.

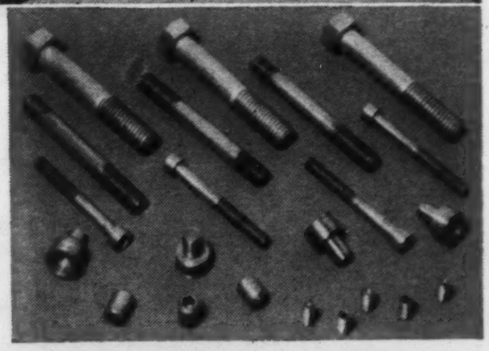
Businesslike dealings with Bolivia's nationalized tin industry on the part of the U. S. Government resulted in an agreement to purchase 10,000 tons of tin concentrate at prevailing market prices rather than at a level tailored to the profit margin of the Bolivian production facilities. The return of Bolivian tin output (boycotted since nationalization) should better the supply picture in the United States and keep prices steadier.

(Continued on page 238)

Surface Allcase Furnaces

put production way up





and costs way down

A consistently rising demand for the Allcase furnace has necessitated production line manufacture. This is the best proof that these batch type radiant tube controlled atmosphere furnaces really have the capacity, versatility, and operating economy to make a small investment pay off quickly. They provide for gas carburizing, marquenching, clean hardening, dry cyaniding, carbon restoration, homogeneous carburizing, and clean annealing. One man can handle several Allcases . . . Gross heating rates are: Standard size: 500 lbs/hr.—Heavy-duty: 1600 lbs/hr. Write for Literature Group H53-8, or better still . . .

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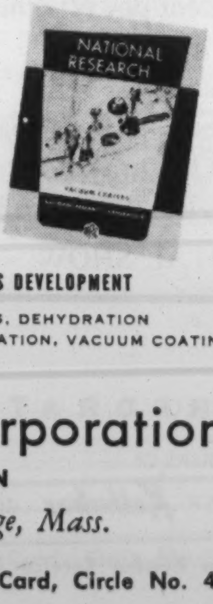

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News Digest

Lead and Zinc

Abandonment of the East St. Louis pricing basis in July and steadily softening zinc prices kept the market in an unsettled state for more than two months. Zinc hit a three-year low price in mid-September and suppliers went back to the East St. Louis basing system at a price of 10½¢ per lb. On the modified basing point system purchasers are to be charged freight, but no more than ½¢ per lb, which in effect means a price of 11¢ per lb maximum. The September zinc price compared with 19¢ early in the year.

The National Lead and Zinc Committee, seeking relief from falling prices, asked the Tariff Commission to raise lead and zinc tariffs 50¢ over the rates of 1945. This would increase the duty on contained lead in ores about 1¢ per lb and on lead about 1½¢ per lb. The duty on zinc would be increased about 1½¢ per lb and on zinc in ore 1.2¢ per lb. The Lead and Zinc Committee is seeking import quotas in addition to higher duties, since an increased rate of importation of lead and zinc is seen as a major cause of the price decline. Since the Tariff Commission is already investigating the lead and zinc market for the Senate and the House Ways and Means Committee, it is likely that the industry committee's request will get an answer in fairly short order.

From a material user's standpoint it looks like low lead and zinc prices will prevail for quite a while. Record imports, record supplies on hand and adequate domestic production add up to plenty of metal to supply industry and plenty of competition to keep the price down.

Precipitation Process Speeds Radium Output

A new way to purify radium by means of precipitation from a homogeneous solution has been per-

For more information, Circle No. 346→

PRODUCT—
Automotive heater shut-off valve
MATERIAL—
Aluminum alloy
EQUIPMENT—
160 kv x-ray machine

What's the right X-ray film?

KODAK INDUSTRIAL X-RAY FILM, TYPE A

A big production run was scheduled. So to check casting methods, pilot castings were radiographed to detect any recurring porosities.

For these exposures, the radiographer used 70 kv, 54-sec. exposure at 36-in. tube distance—no lead screens—and Kodak Industrial X-ray Film, Type A.

This film is the first choice for examination of light alloys with short exposures at low voltages. It also has high contrast with fine graininess and speed enough to take full advantage of high kilovoltage equipment in radiographing thick or dense materials.

A RIGHT FILM FOR EVERY PROBLEM

Whatever your radiographic problem, you'll find the best means of solving it in one of Kodak's four types of industrial x-ray film. This choice provides the means to check castings and welds efficiently, offers optimum results with varying alloys, thicknesses and radiographic sources.

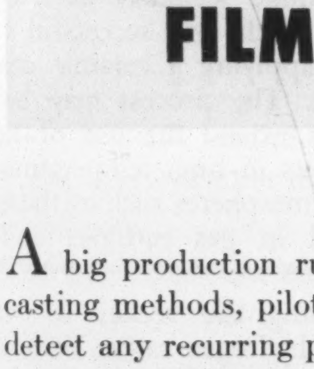
Type A—has high contrast and fine graininess with adequate speed for study of light alloys at low voltage and for examining heavy parts at intermediate and high voltages. Used direct or with lead-foil screens.

Type M—provides maximum radiographic sensitivity, with direct exposure or lead-foil screens. It has extra-fine grain and, though speed is less than Type A, it is adequate for light alloys at average kilovoltages and for much million- and multi-million-volt work.

Type F—provides the highest available speed and contrast when exposed with calcium tungstate intensifying screens. Has wide latitude with either x-rays or gamma rays when exposed directly or with lead screens.

Type K—has medium contrast with high speed. Designed for gamma ray and x-ray work where highest possible speed is needed at available kilovoltage, without use of calcium tungstate screens.

Radiography . . . another important function of photography



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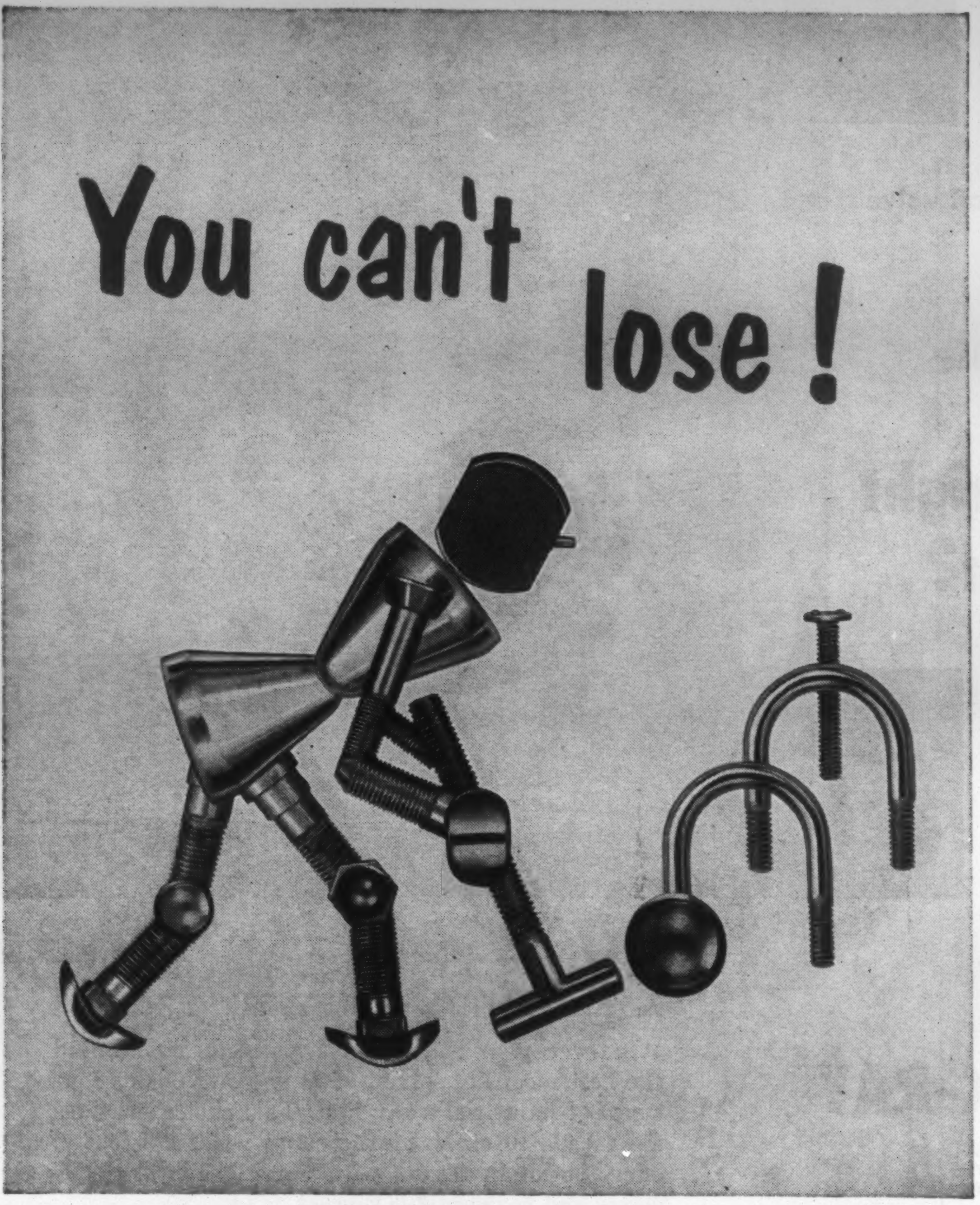
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fected at Mound Laboratory. Radium and barium are about as inseparable as Siamese twins and they occur together in every commercial source of radium ore. Reduction of pure radium from a radium-barium solution by the Curie process of fractional crystallization takes hundreds of steps and many weeks to process a single batch of ore for its contained radium.

The new process, according to Mound scientists, produces commercially pure radium in faster and fewer steps of purification and can separate radium in only a few days from ore containing 10 parts of radium per million parts of barium.

The new process should eventually result in lower cost and greater availability of radium for industrial radiographic uses.

Ceramic Coating Applied to Nickel

Oak Ridge scientists have developed one of the first successful methods for applying a ceramic coating to nickel. The process may be expected to extend the use of nickel components in high temperature oxidizing atmospheres such as those encountered in gas turbines and jet engines.

Annealing the nickel in water-saturated hydrogen rather than a dry hydrogen atmosphere is the factor controlling surface coating durability and improved adherence in the new process. Nickel parts were annealed in water-saturated hydrogen at a temperature of 1000 F, sprayed with NBS ceramic coating A 418, dried and fired. Coating durability tests in a 1500 F oxidizing atmosphere with exposure times up to 65 hr showed improved adherence of the coating and unimpaired appearance. Similar exposures of ceramic coated dry-hydrogen-annealed nickel produced bubbly surfaces and rapid deterioration of the coating bond.

Scientists of the Ceramic Dept. of the Union Carbide operated Oak Ridge National Laboratory are responsible for the new coating method, which was developed as an adjunct of developmental work on the use of ceramic coatings for reactor requirements.

"How can I get a faster quench?"

"What will step up my production on these grinders?"

"I need 15% more machining speed, with enough cooling"

"What will give me less rejects on these castings?"

"How can I prevent rust on these machined surfaces?"

"I need a drawing lubricant that will reduce press downtime"

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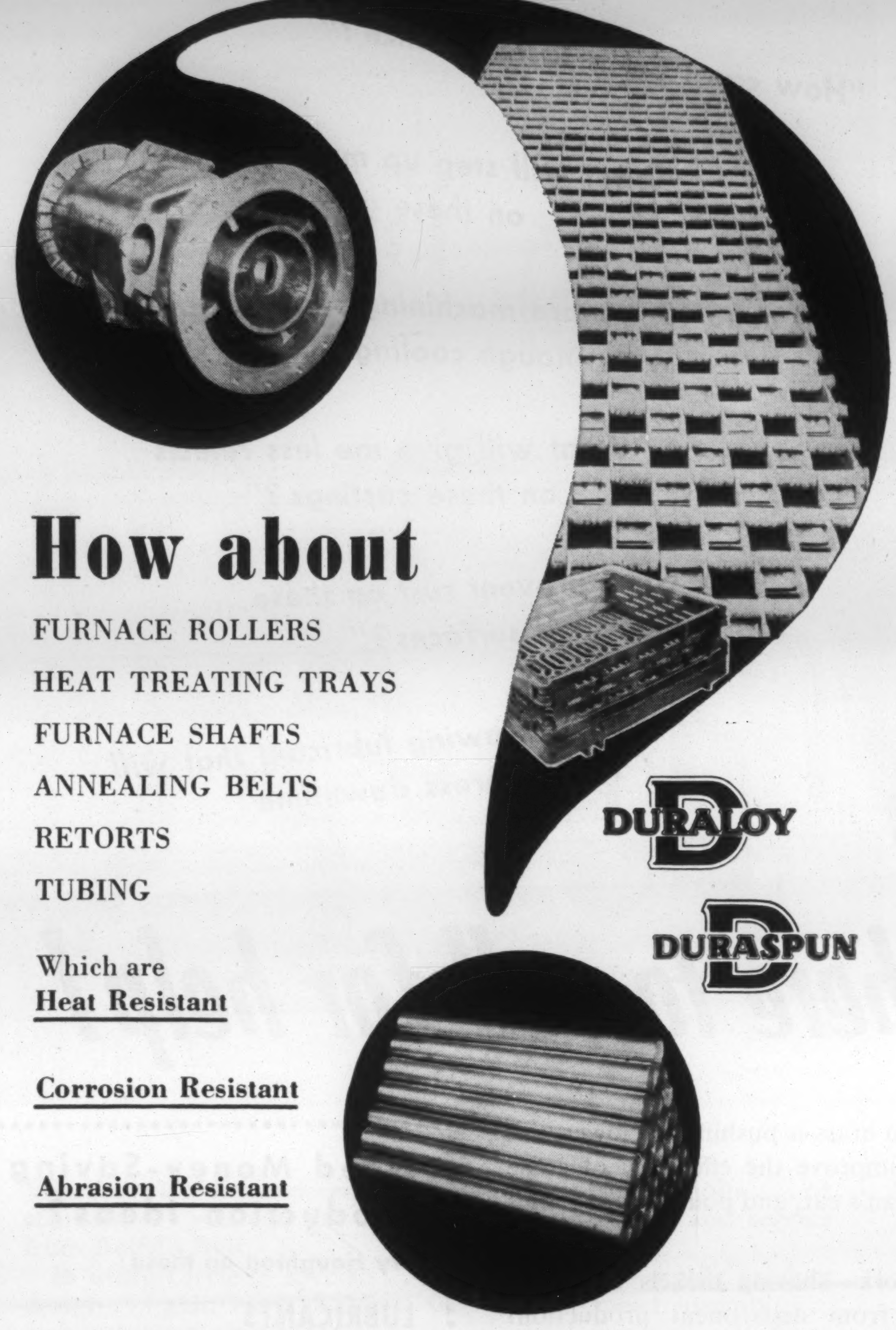

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News Digest

Baking Enamel . . . .

continued from page 7

of a whole new family of water soluble baked finishes and will soon be joined by water soluble urea and melamine enamels that will accomodate lighter pigments.

Enamel Qualities

The baked enamel finish obtained with the water soluble material reportedly has excellent hardness and corrosion resistance combined with good adherence and flexibility to the extent that coated metal may be deep drawn after curing. Since the basic solution is infinitely dilutable with water it may be easily tailored to coverage and flow properties necessary in all types of commercial application techniques from spraying to dipping.

Mr. Brown said that the cured enamel is very hard—"considerably harder than conventional alkyd-urea resin finishes" and has "excellent" adhesion characteristics with all metal surfaces including copper and light metals. The cured enamel is highly resistant to water and weather and offers protection from oils, solvents, and gasoline. Because it is flexible enough to permit deep pressing, Brown expects to see it widely used in such applications as printed bottle caps, toys and containers as well as in more durable metal products such as farm machinery and automobile finishes.

Developed in Austria

The new enameling material was developed by Dr. Herbert Hoenel of the Vianova Corp., Graz, Austria. In a talk to a group of chemists associated with the paint and finishing industry in Europe, he described the product as three chemically combined ingredients which yield a water soluble material in the form of a soap, which when diluted with water provides a homogeneous film-forming solution of the consistency of varnish.

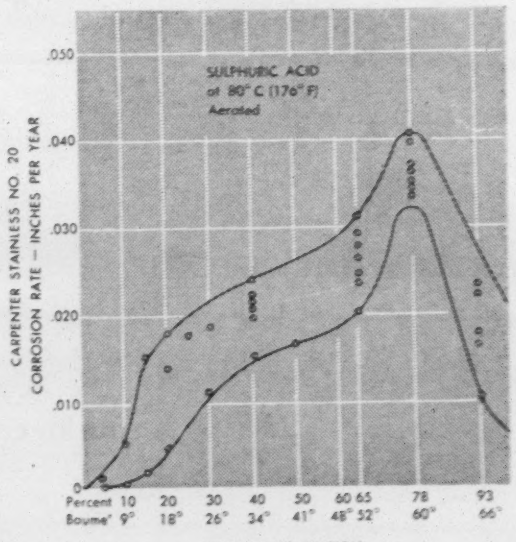
The components of Hydrophen are: a resol, or phenol alcohol, which confers hardness and abrasion resistance; an alkyd-resin plasticizer, which gives flexibility and prevents cracking and checking; and ammonia, or one of a number of nitrogen bases, which acts as a saponifier with the alkyd constituent to make the enamel

Corroded and failed after four days' service
(Unretouched photo)
No apparent corrosion after 256 days of use
(Unretouched photo)

Is the Handling of Corrosive Acids, such as Sulphuric, Causing Headaches in Your Plant?

Today many plants are enjoying new freedom from corrosion, longer equipment life and fewer shutdowns . . . because of Carpenter Stainless No. 20. Take the job shown above. In this application, ½" rd. rods of Carpenter No. 20 and Stainless Type 316 were installed to handle H_2SO_4 at the rate of about 50 gallons a minute in a full range of solution varying from 0% up to 58% concentration. Temperature: 70° C. (158°F.). After four days the Type 316 rods failed and were replaced with ½" sq. No. 20 rods. After being in service 3,747 hours of a possible 6,144 hours over a period of 256 days, the No. 20 rods showed no apparent corrosion whatsoever. (See unretouched photo above.) Of course, Type 316 is satisfactory for certain dilute solutions of H_2SO_4 and many other corrosive conditions. But with a tough problem like the one described here, it takes No. 20 to do the job.

While the production of Stainless No. 20 is controlled by Government Regulations, you may be able to obtain Government approval of its use, depending on the nature of your job. If not, keep these facts in mind because of their importance in your planning for future products. Meantime, write on your Company letterhead for more details in the No. 20 booklet. Also, get in touch with us for No. 20 test coupons. We'll be glad to work with you. The Carpenter Steel Company, 135 W. Bern St., Reading, Pa.



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completely water solvent at this stage. The nitrogen base must be added to the first two ingredients shortly before use to prevent undesirable aging, as the mixture is too unstable for long storage periods. Dr. Hoenel suggested adding the base at the time of dilution in the paint shop, since it is a relatively simple process.

Limitations and Qualifications

Mr. Brown freely admitted that a serious problem exists concerning the pre-drying of the enamel before curing. Since water has a heat of vaporization ranging from 2 ½ times that of ethanol to 7 or 10 times that of white spirits, a different drying technique is necessary. For a production system, either a long drying period or installation of a forced hot air system is required.

The aqueous solution of the enamel reportedly has excellent covering and flow qualities with or without pigments and extenders. However, the surface to be coated must be completely free of grease, or bare spots and cratering will result. Conventional pickling, bonderizing, or spray cleaning with an aqueous degreasing agent is sufficient in most instances.

Baking temperatures are within the range of most equipment now installed but must be over 320 F and preferably 340 F or even higher. A curing time of 10 or 15 min is sufficient, but a longer bake will increase resistance to boiling water and solvents.

Since phenol resins turn yellow on curing, only strong, dark pigments may be used with Hydrophen, but both Dr. Hoenel and Mr. Brown say that it is only a matter of time until urea and melamine water soluble enamels are on the market, since development work has been virtually completed. These lighter colored enamel bases will take any colors.

Field Applications and Price

The application of baked enamel coatings to large structures such as water tanks, bridges, and condensing towers subject to intense corrosion has come a step closer with the development of water soluble enamels, Brown believes. The metal structure is flame cleaned, which removes grease and heats the surface to speed drying of the enamel, which is sprayed on immediately from a com-

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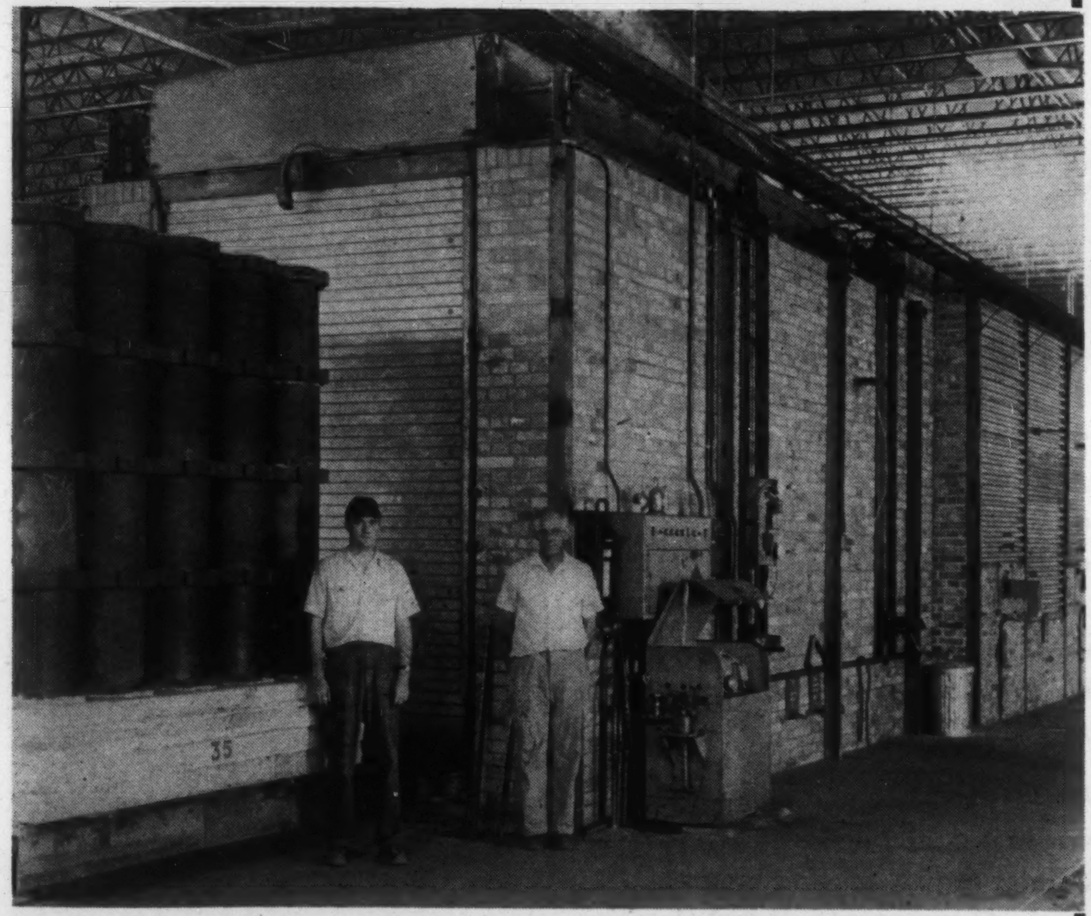

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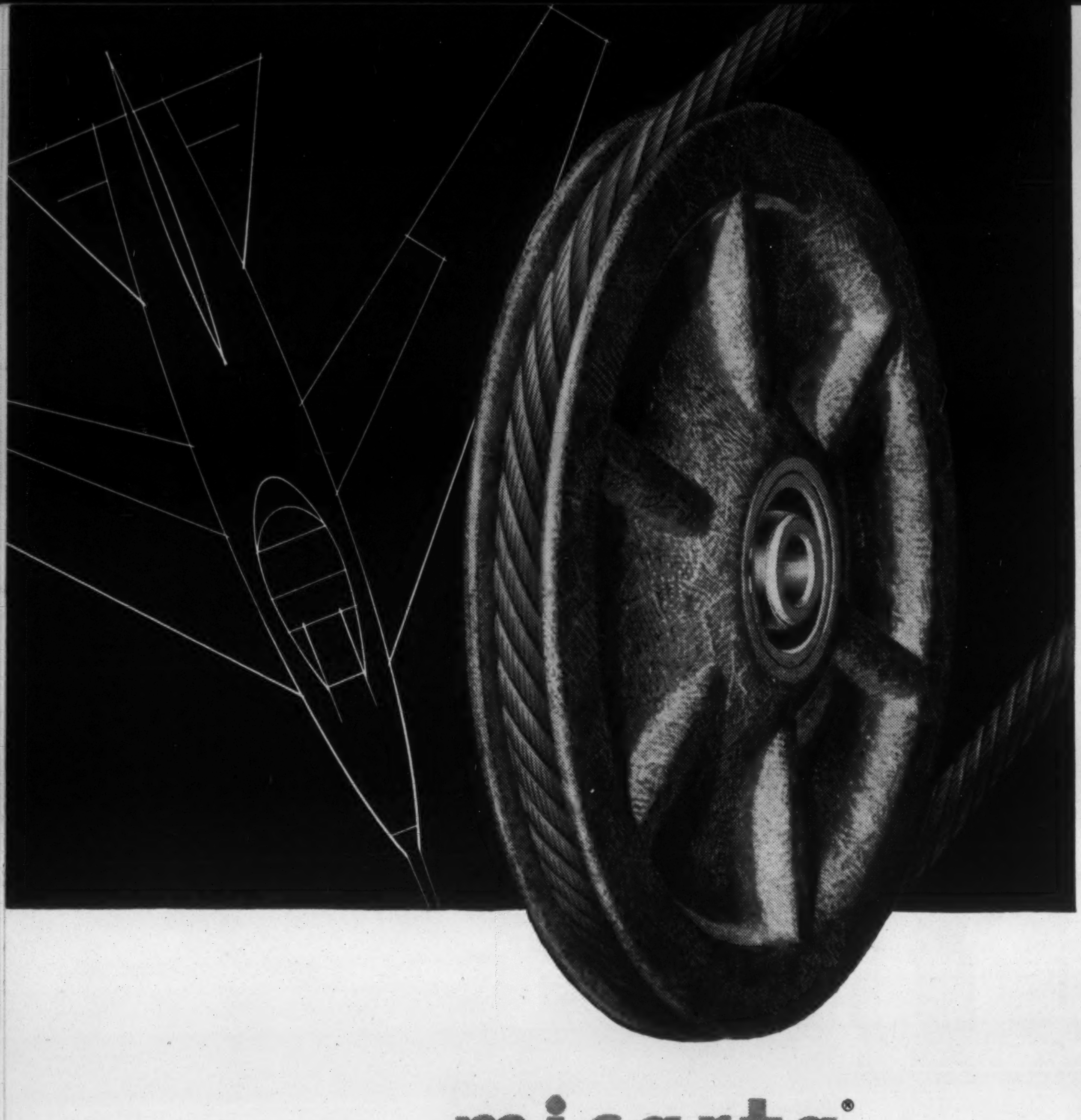

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bination gun. The same flame gun can be used to cure the resin after pre-drying is complete, and since phenolic resins change color upon setting, the degree of bake can be judged visually by the flame gun operator.

Price structure of the new enamel is not yet final, depending on production costs. However, estimates are that savings up to 25% will be possible in material costs, and that the elimination of fire and health dangers will decrease many hidden costs by improving working conditions and reducing insurance rates.

Record Refrigeration Show in November

The booming refrigeration and air conditioning industry will hold the biggest exposition in its history in Cleveland on Nov. 9-12, 1953. Display space, snapped up by over 225 companies in the field, has been sold out since late summer. This exposition is expected to cover a wider range of refrigeration and air conditioning equipment than ever before; a reflection of the increased use of refrigeration techniques in industrial, shipping and residential fields.

In the industrial field, the exposition will feature equipment for use in low temperature processes, atmosphere control and dehumidification.

Battelle Sees Need for Earth Crust Research

A great need exists for more basic and fundamental research on the distribution and relationships of elements in the earth's crust, according to Battelle Memorial Institute scientists. While recognizing many recent improvements in mineral recovery techniques and prospecting instruments, the scientists claim that the key to unlocking the earth's hidden mineral wealth lies in the laboratory, where fundamental studies of the origin and formation of ore bodies and aggressive development of new and improved prospecting instruments

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In the field of chemistry, tin is making impressive strides. Tin oxide is the best opacifier of enamel. Organotin compounds are the best stabilizers known for polyvinyl chloride plastics.

Now that U.S. Government controls have been removed, tin is again freely available in this country to *any* user, in *any* quantity, for *any* purpose. Over a third of the world's tin is mined in Malaya. There are ample supplies of tin in sight for the foreseeable future, provided a reasonable price is paid. And Malaya is steadily winning its war against Communist guerrillas.

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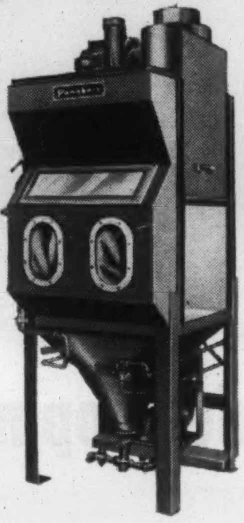

Pangborn Hydro-Finish Cabinet—Removes scale and directional grinding lines . . . holds tolerances to .0001″ and prepares surfaces for painting or plating. Liquid blast reduces costly hand cleaning and finishing of molds, dies, tools, etc. Models from . . . **$1410** and up.

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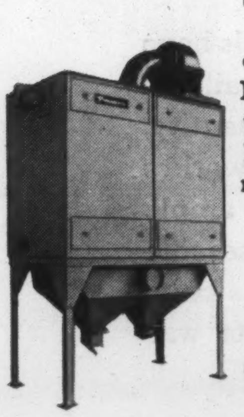

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will increase mineral recovery potential.

Status of Research

Battelle director Clyde Williams writes, "[Present] accumulated observations . . . provide only rough ideas about the elements in the earth's crust. More laboratory research in minerology and crystal chemistry would lead to better understanding of mineral relationships. This knowledge could explain why ore is where it is and aid in selecting the most promising areas for survey".

New Trends

Williams and his associates enumerate a number of opportunities awaiting development ranging from pure research to relatively simple practical improvements in prospecting instruments and techniques. They point to the new trend of thinking on minerals exploration that has evolved since World War II under the impetus of rapid depletion of rich and obvious mineral deposits. Today the modern prospector must think in terms of searching for deposits lower in grade, more deeply buried, or geographically isolated. Prospecting for less obvious mineral deposits demands knowledge of basic minerological principles and requires instruments capable of finer measurements over larger geographical areas.

Present Opportunities

Among the opportunities for improving prospecting instruments the Battelle staff lists many that are immediately possible. The miniaturization of common geophysical instruments would permit lowering them into bore holes, with improved bore hole analysis the result. Fundamental research in seismic and electrical exploration methods could increase the accuracy and detail-recording capacity of present instruments.

Greater depths could be plumbed by increasing the power output of electrical prospecting instruments. More rapid interpretation of information could be accomplished by adapting electronic computers for recording geophysical data. And such a simple step as the development of a truck mounted, total field, continuous reading magnetometer similar to those used in aerial mapping would facilitate magnetic prospecting.

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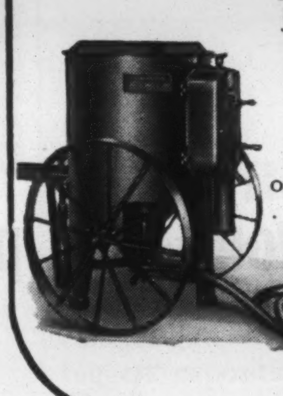

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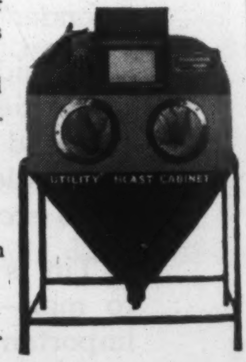

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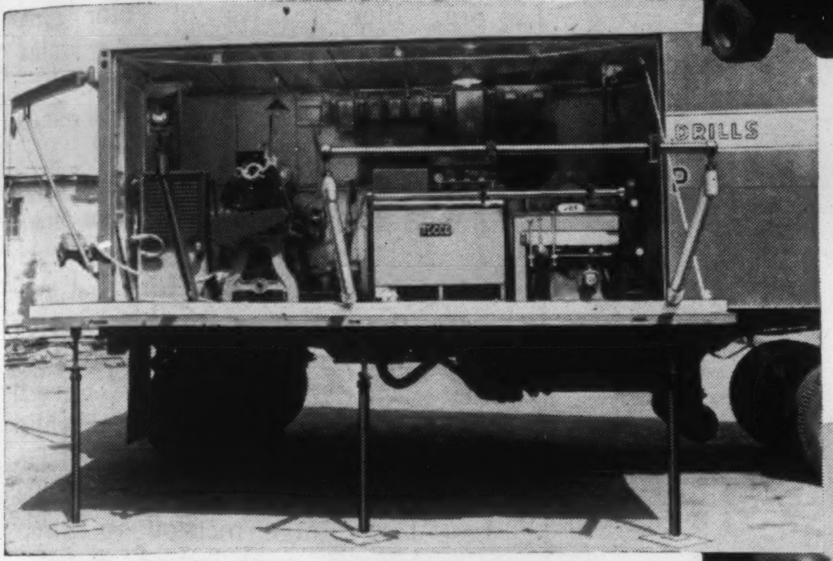


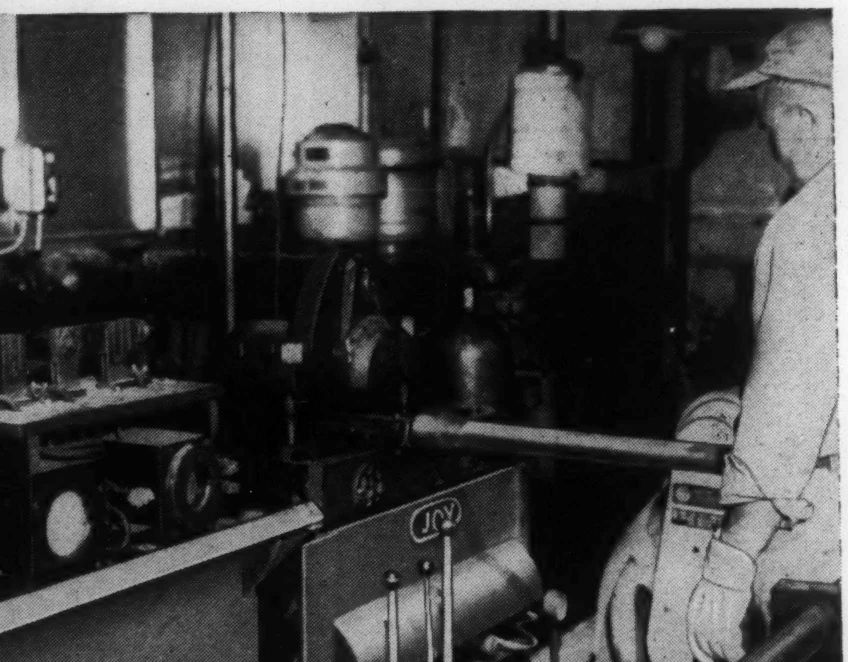
Joy Manufacturing Company's Mobile Shop for on-location reconditioning of mine drill steels.

BECAUSE of the size and length of mine drill steels, (some weigh as much as 320 lbs. and are 30 ft. long) much expense and lost time was involved in shipping them back to the factory for reconditioning. Realizing this problem, Joy Manufacturing Co., Pittsburgh, Pa., decided to send "Mohammed to the mountain" in the form of the *Joy Mobile Shop.*

The purpose of the Mobile Shop is to travel to designated territories in the United States, calling periodically on users of Joy's "Challenger" Drill. All broken drill steels are reconditioned on the spot—saving Joy's customers transportation costs and lost time.

The Joy Mobile Shop carries a 20 KW, 10000 cycle TOCCO Induction Heating machine, powered by a diesel-electric generator. The TOCCO unit heats the drill steels to 2200° F for upsetting, then reheats the upset ends to 1500° F for normalizing prior to machining.

This unusual application story is typical of the way TOCCO engineers team up with American Industry for better products and services, faster—and at lower cost.



Operator guiding drill steel in upsetter after heating end to 2200° F in TOCCO machine at left.

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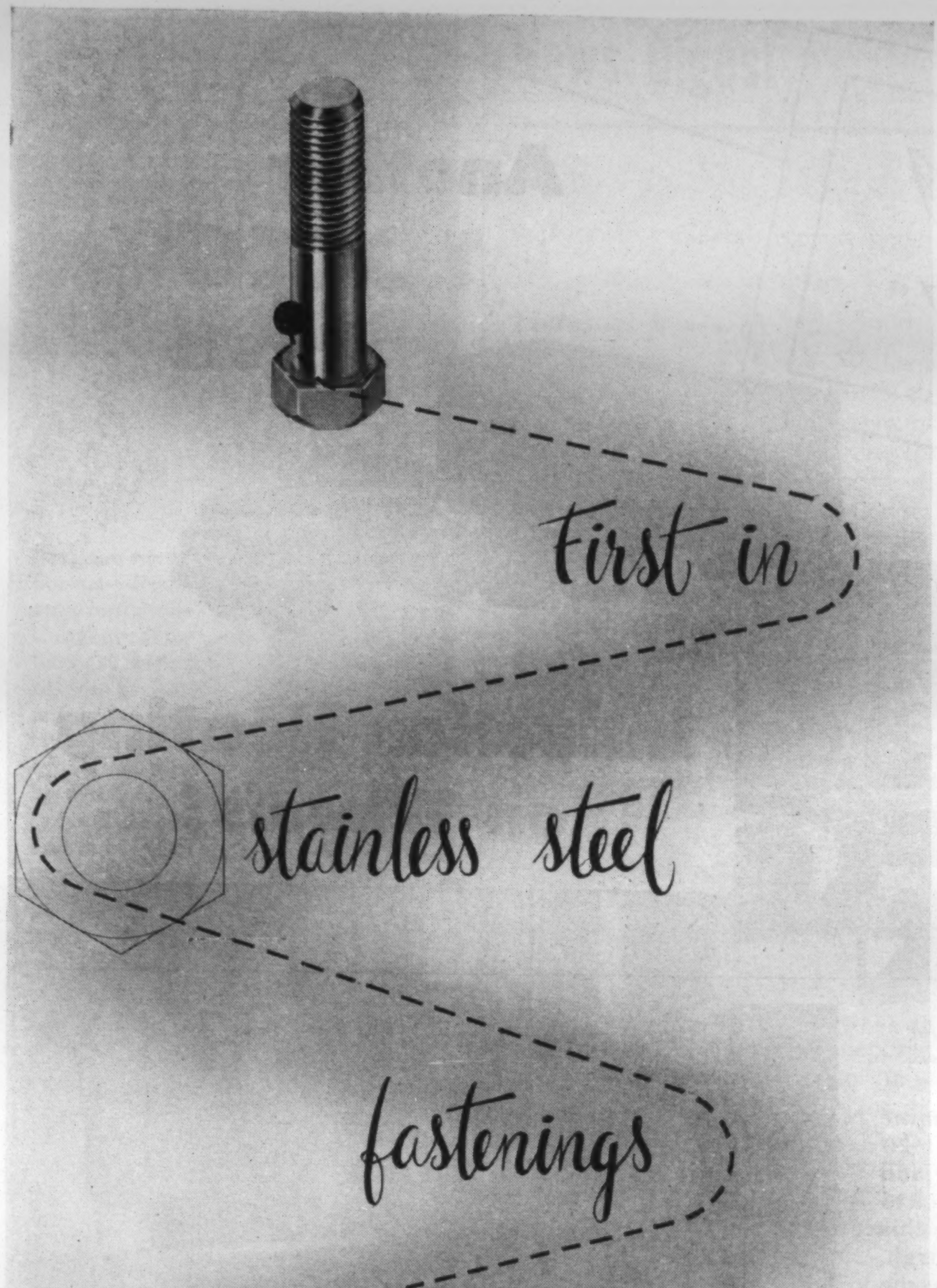

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News Digest

Recent Progress

Since the war, many companies have participated heavily in developmental work toward improved prospecting methods. The Geiger-Muller counter and scintillation counter have become standard tools for searching out radioactive materials. Airborne instruments, such as the magnetometer, have aided immeasurably in geophysical mapping, and have located some major deposits of iron ore. Increased use of color aerial photography, and pinpoint examination by helicopter have increased the possibilities for exploring remote areas.

Important advances in concentrating lean ores have made low grade mineral deposits much more significant in the supply picture, but even with the progress in the last few years, the Battelle scientists point out that actual recoveries of mineral resources lag far behind potential exploitation. They feel that far-sighted fundamental research is the best long range method to ensure recovery of earth-locked materials that have not yet been touched.

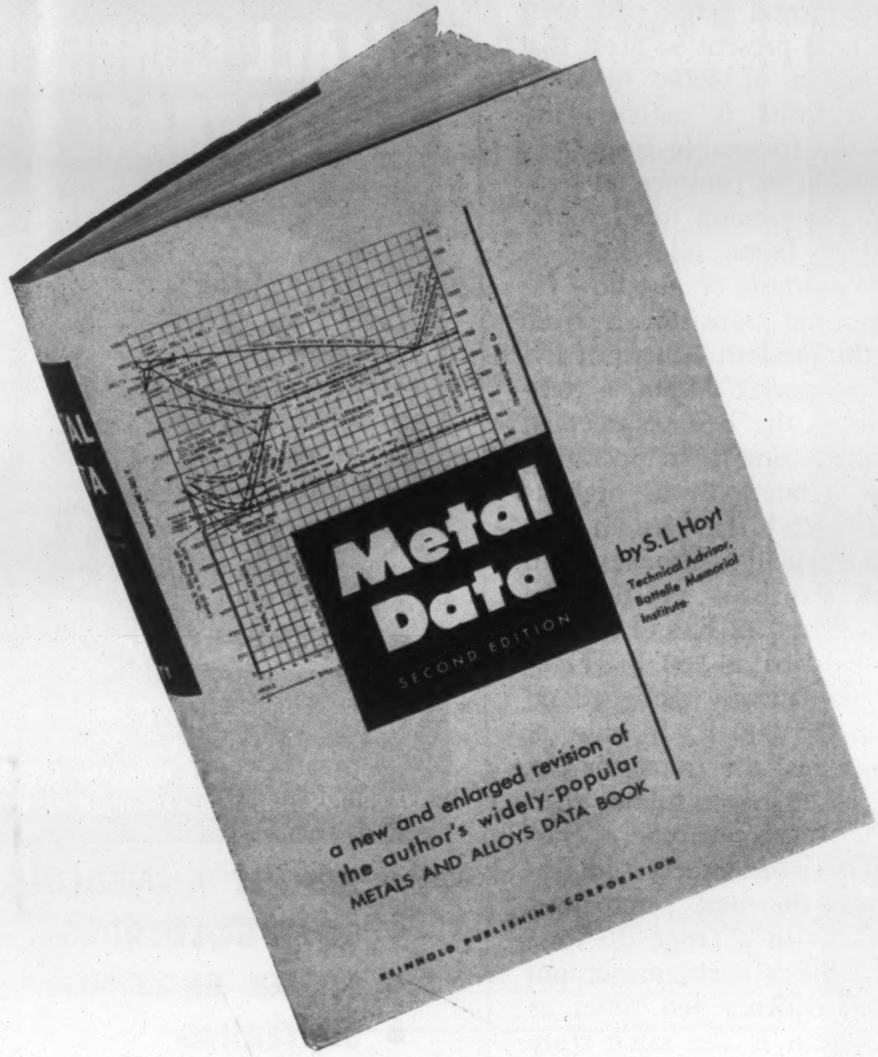
Transistor Not a "Work Horse"...Yet

In a realistic appraisal of the current status of the transistor in electronics, D. G. Fink of the Philco Corporation said in a luncheon address to WESCON in San Francisco, "From an application point of view, the transistor is indeed surrounded by disappointments. Of the many commercial applications forseen in 1948 only two have come to pass in 1953; the transistor is used in telephone exchanges and is beginning to find use in hearing aids."

Among the more serious disappointments experienced with the transistor, Mr. Fink listed moisture poisoning, spontaneous appearances of defects in the germanium, temperature instability, mechanical breakdown for no assignable cause, high noise and difficulty in manufacture. On all comparable bases with the single exception of the efficient amplification of small signals, the vacuum tube still outperforms the transistor in margins that put them in different magnitudes. Mr. Fink's comments applied to commercially available transistors only, and he pointed out that experimental transistors do exist that outperform

Instant information for

METALLURGISTS • MATERIALS ENGINEERS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This brand-new edition of the author's widely-used *Metals and Alloys Data Book*, similar in form to its popular predecessor, not only includes the most recent information available, but offers a wealth of new data on such topics as hardenability of H-Steels, the recently developed Super Alloys for high-temperature stress members, and other new alloys.

The original purpose of the book has been adhered to in this second edition: to select important data from reliable sources, and to present them to metallurgists and engineers in a form usable for daily reference. As a result, the bulk of the material is offered in at-a-glance tabular form with a minimum of descriptive text. Nearly 700 tables and graphs bring you useful working information on such metallic properties as tensile strength, hardenability, thermal expansion, creep strength, endurance limit and yield strength at normal, sub-normal, and elevated temperatures, and for various conditions of mechanical treatment. Numerous special features include a listing of commonly used test bars, hardness tests, corrosion data, conversion factors, applications of materials and the properties of elements. Here you'll find full information not only on all of the important metals and alloys but on many of the less common metals as well.

Expressly designed for the needs of all materials engineers and metallurgists, METAL DATA, Second Edition, will prove essential for the technical personnel of all metal-using industries. Producers of steel, copper, brass, aluminum and other metals and alloys will also find the book a handy, rapid reference source of day-to-day working information.

1952, 526 pages, 7 x 10, $10.00

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News Digest

standard units, but the distance between experimental stage and mass production is at present so great that mass production of some types of experimental units is patently impossible in the forseeable future.

A comparison of commercial transistors with the vacuum tubes found in a standard home television set provided an example of just how far the five year old transistor is from a place in the modern American living room. In power output, a common tube beats the best commercial transistor by 75 times. In operating temperature, (commonly as high as 200 F in TV sets) the vacuum tube has no particular limitations within reason, but transistor performance begins to slide at 122 F, and is completely substandard at 160 F. Transistors are permanently damaged on long exposure to 200 F. In noise at audio frequencies, the transistor has a noise figure 20 times higher than any commercial vacuum tube operating in similar circumstances. In frequency range, the best commercial transistor works in a range up to 2 megacycles, while a common vacuum tube hits a frequency ten times as high. Bandwidth is the same story according to Mr. Fink—the intermediate frequency amplifier tubes in a television set have a bandwidth of three and ten times that of commercial junction and point contact transistors, respectively.

One of the great expectations from the transistor was long life—years ago the most conservative sources estimated an operational life for transistors of more than eight years. Mr. Fink had some cold water to throw on that, too. He claimed that no one today knew for sure how to make a commercial transistor that had a shelf life of 10,000 hr, let alone an operational life of 70,000. He pointed out that transistors have a way of "turning over in their sleep, so to speak" because of spontaneous appearances of defects in the germanium itself. That, in addition to mechanical failure of connections for no understandable reason, is why there is as yet not one single operational application of transistors in the armed forces, where the vast majority of the first commercial transistors went.

Sees Future Promise

The dismaying state of commercial transistors today in the light of the great expectations of 1948 is not

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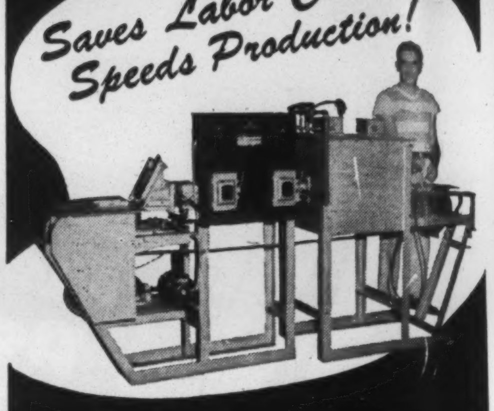

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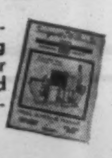

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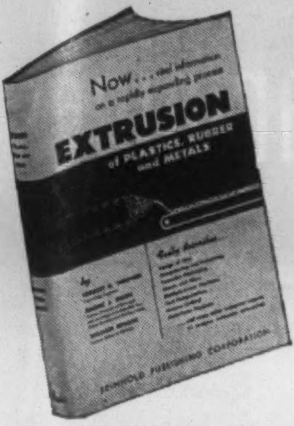
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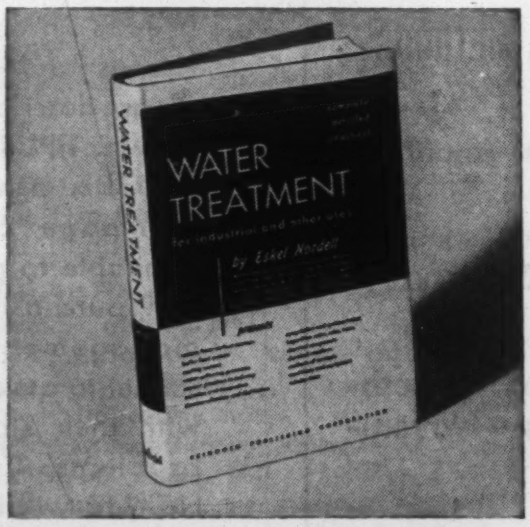
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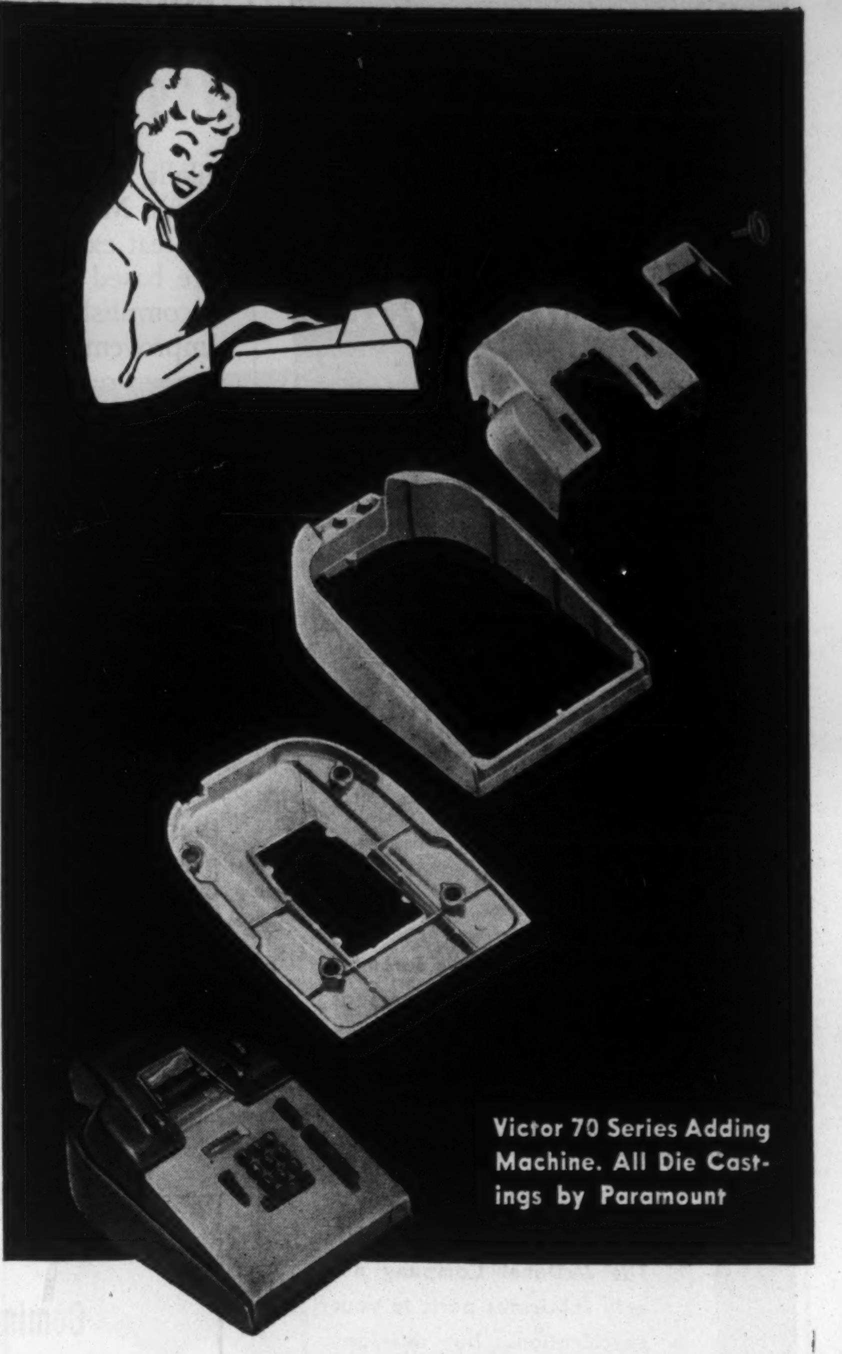

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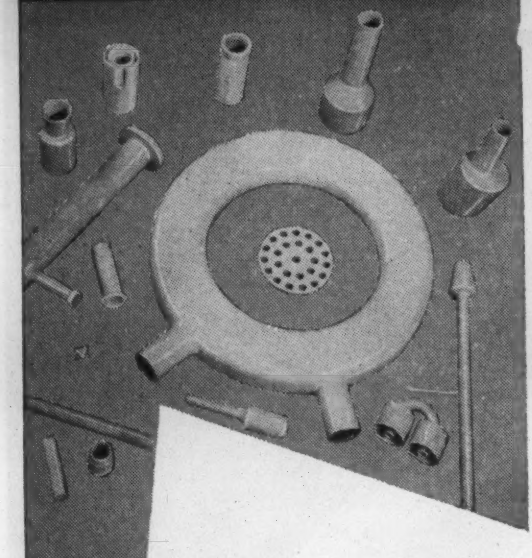

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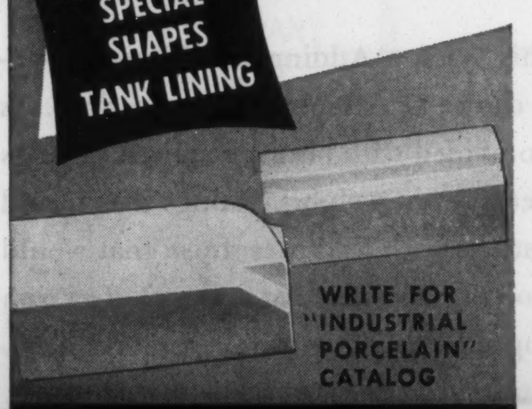

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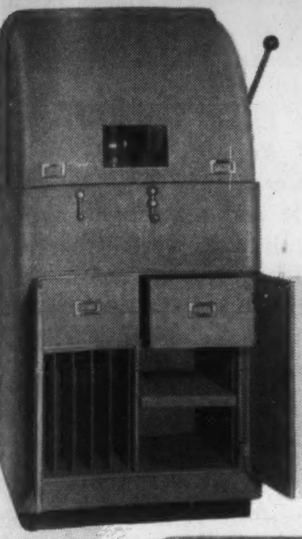

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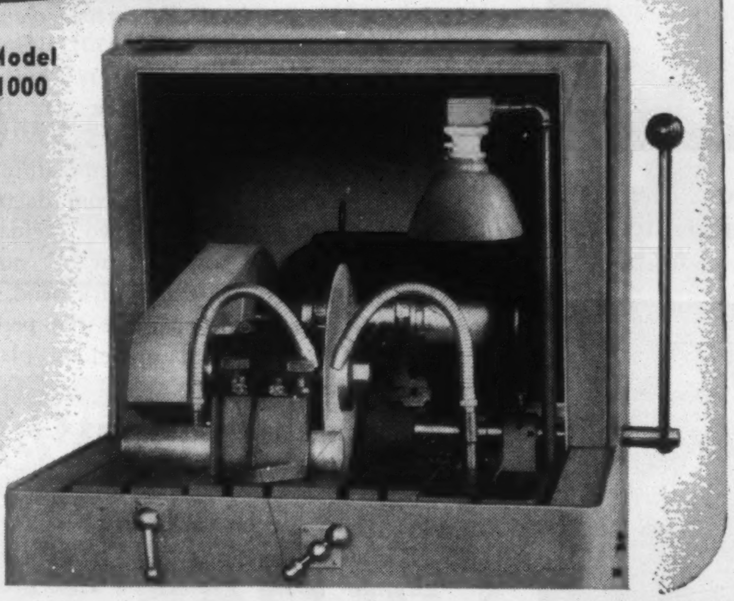

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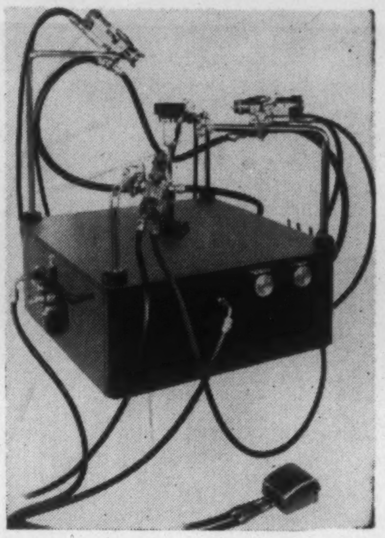

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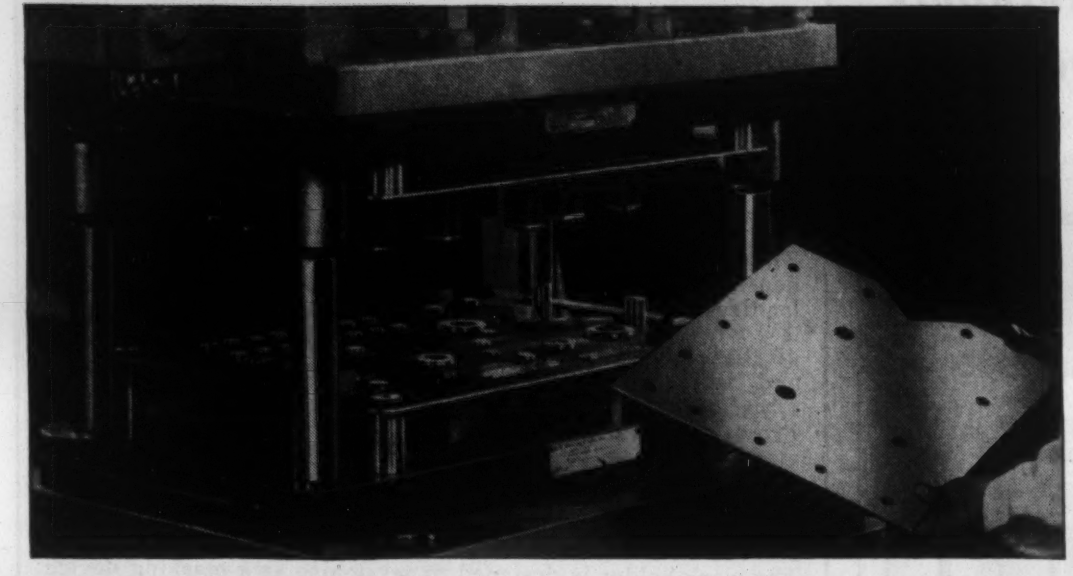

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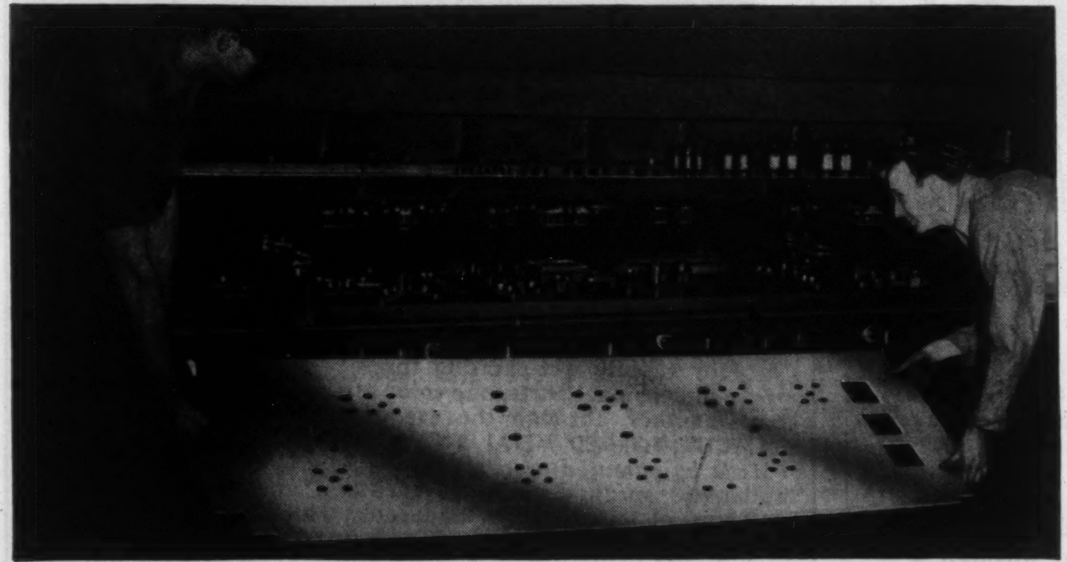

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Technical Reports on Materials

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EFFECT OF ALLOYING ELEMENTS ON THE HARDENABILITY OF STEEL; PARTIAL REPORT. *I. R. Kramer, U. S. Naval Research Laboratory. 39 pp. Report 109450. Available from Library of Congress Publication Board Project, Washington 25, D. C. Microfilm $2.25, Photostat $5.00.* Factor principle and magnitude of effect confirmed for alloying elements manganese, silicon, nickel, copper and molybdenum and the effect of columbium, cobalt, beryllium, antimony, arsenic, tellurium and germanium has been determined.

INVESTIGATION OF THE EFFECTS OF WELDING ON THE TRANSITION TEMPERATURES OF NAVY HIGH TENSILE LOW ALLOY STEELS. *Metius, Laxar, and Hartbower. U. S. Naval Research Laboratory. 41 pp. Report PB 109477. Available from the Library of Congress Publication Board Project, Washington 25, D. C. Microfilm $2.50, Photostat $3.75.* Welding raises the transition temperature of a steel at which a change from ductile to brittle failure occurs. Two weldability test specimens, the Charpy V notched bar and a high constraint nick bend specimen were used to compare the performance of welded and unwelded plate at various temperatures.

MICRORADIOGRAPHY OF GRAY CAST IRON. *E. I. Salkovitz, J. H. Schaum and F. W. Von Batchelder. U. S. Naval Research Laboratory. 26 pp. Report 109421. Available from Library of Congress Publication Board Project. Washington 25, D. C. Microfilm $2.00, Photostat $3.75. A limited supply is available from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C., $.75.* The microradiographic technique is described by which graphite in gray cast iron may be studied with conventional X-ray equipment. Photomicrographs and microradiographs are included to permit comparison of the graphite as it appears in the two different methods.

RESEARCH ON THE WELDABILITY OF IRON ALLOYS (WELDABILITY TESTS OF CAST STEELS). *McKenna and Fritz. U. S. Naval Research Laboratory. 26 pp. Report PB 109327. Available from Library of Congress Publication Board Project, Washington 25, D. C. Microfilm $2.00, Photostat $3.75. Limited supply available from Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. NRL M 2379, $.75.*

PROPERTIES OF QUENCHED AND TEMPERED HTS PLATE. *Westfall and Dumphy. U. S. Naval Research Laboratory, 1947. 42 pp. Report PB 109271. Available from Library of Congress Publication Board Project, Washington 25, D. C. Microfilm $2.50, Photostat $6.25.*

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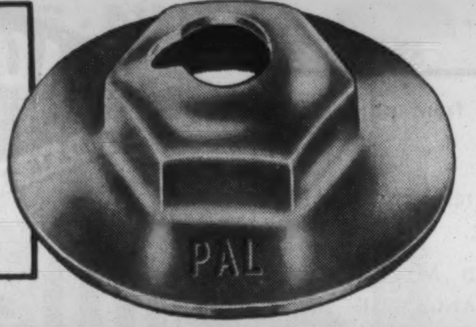

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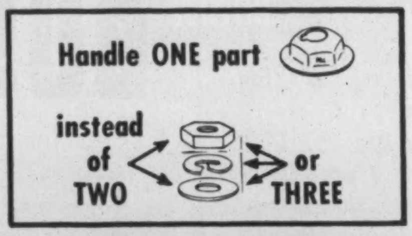
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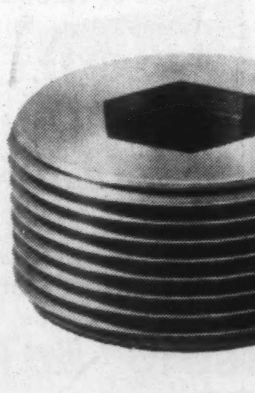

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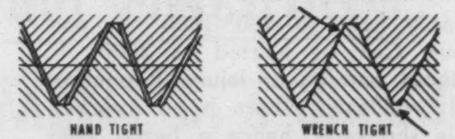
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Technical Reports . . .

continued from page 256

Improved fracture characteristics of HT grade sheets by tempering.

Thermal Behavior and Mechanical Properties of Iron-Manganese and Iron - Manganese - Nickel Alloys. *Kramer, Toleman, Haswell. U. S. Naval Research Laboratory. 42 pp, Report PB 109332. Available from Library of Congress Publication Board Project, Washington 25, D. C. Microfilm $2.50, Photostat $6.25.*

Welding and Properties of Welded Tubing of the SAE X4130 Composition. *Jackson, Luther, and Pugacz. U. S. Naval Research Laboratory. 9 pp, Report PB 109455. Available from the Library of Congress Publication Board Project, Washington 25, D. C. Microfilm $1.25, Photostat $1.25.*

Nonferrous

Causes for Porosity and Leakage in Nonferrous Castings. *R. A. Colton. U. S. Naval Research Laboratory, 1945, 32 pp. Report PB 109277. Available from Library of Congress Publication Board Project, Washington 25, D. C. Microfilm $2.25, Photostat $5.00* A series of controlled experiments on the effect of phosphorus in gun metal castings.

Comparison of the Corrosion Resistance of Aluminum Alloy Assemblies Anodized in Sulphuric and Chromic Acid. *Burwell, Sierichs, and McConnaughey. U. S. Naval Research Laboratory, 1945, 18 pp. Report PB 109463. Available from Library of Congress Publication Board Project, Washington 25, D. C. Microfilm $1.75, Photostat, $2.50.*

Dry Pressed Aluminum Titanate-Aluminum Silicate Turbine Stator Blades. *Nelson, Wilmore, Bennett. University of Illinois, Dept. of Ceramic Engineering, Urbana, Ill., 1950. 16 pp., Report PB 108673. Available from Library of Congress Publication Board Project, Washington 25, D. C. Microfilm $1.75, Photostat $2.50.*

Effect of Notches on the Fatigue Strength of Three Light Alloys. *Taylor, Gunn. Great Britain Royal Aircraft Establishment, Farnborough, England. Aug. 1950. 66 pp. Report PB 109417. Available from the Library of Congress Publication Board Project, Washington 25, D. C. Microfilm $3.00, Photostat $8.75.* Notched bar tests on aluminum and magnesium-zirconium alloys.

Mechanical Properties of Titanium Third Quarterly Progress Report Part II. May 1, 1951 to Aug. 1, 1951. *Rosi, Perkins, Alexander. Sylvania Electric Products, Inc., Metallurgical Laboratories, Bayside, N. Y. Feb. 1952. 47 pp., Report PB 109416. Available from Library of Congress Publication Board Project, Washington 25, D. C. Microfilm $2.50, photostat $6.25.* Tensile properties of commercial titanium investigated in the

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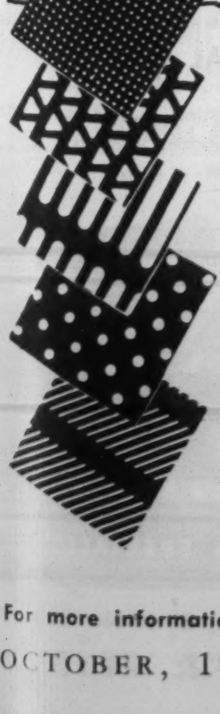

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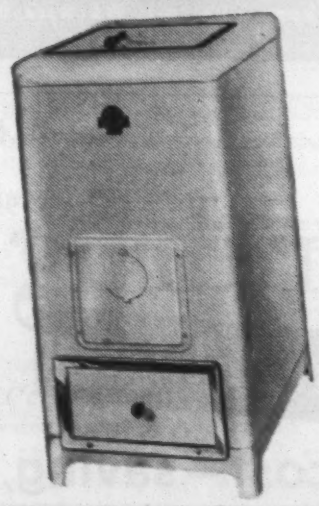

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Technical Reports . . .

continued from page 258

temperature range 77K to 925K at constant strain rates. Results showing usual mechanical effects associated with strain aging.

STUDY OF FORM FACTORS FOR ALUMINUM ALLOY I BEAMS. *J. R. Holt. Rensselaer Polytechnic Inst. 59 pp. Report PB 109832. Available from Library of Congress Publication Board Project, Washington 25, D. C. Microfilm $2.75; Photostat $7.50.*

THERMAL EXPANSION COEFFICIENTS OF CHROMIUM, TITANIUM AND ZIRCONIUM CARBIDES. *Great Britain Royal Aircraft Establishment, Farnborough, England, 1950. 15 pp., Report PB 109297. Available from Library of Congress Publication Board Project, Washington 25, D. C. Microfilm $1.75.*

WELDABILITY OF REYNOLDS R301T WROUGHT ALUMINUM ALLOY. *W. R. Apblett, U. S. Naval Research Laboratory, 1945. 25 pp. Report PB 109481. Available from the Library of Congress, Publication Board Project, Washington 25, D. C. Photostat $3.75; Microfilm $2.00.*

Plastics

DIELECTRIC BREAKDOWN OF PLASTICS AT RADIO FREQUENCIES. *J. J. Chapman, J. W. Dzimianski, C. F. Miller. Johns Hopkins University, July 1949. Report PB 109419. 59 pp. Photos, Graphs, Tables. Available from Library of Congress Publication Board Project, Washington 25, D. C. Microfilm $2.75, Photostat $7.50.* Results of examination of the dielectric breakdown of ceramics, rigid thermoplastics, molded thermosetting and laminated thermosetting materials under radio frequencies. Data are useful for design and development of radio frequency devices.

TEST ON INSULATING MATERIAL MOULDARTA 192-A. *Submitted by Westinghouse Electric and Manufacturing Co. R. L. McFolin, U. S. Naval Research Laboratory. Aug. 1943. Report PB 109318. Available from Library of Congress Publication Board Project, Washington 25, D. C. Microfilm $1.75, Photostat $2.50. Limited supply available from Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C., $.50.*

TEST OF THERMACOTE PROTECTIVE COATING. *Submitted by Thermacoat Co., Los Angeles, Calif. F. M. Holcomb. U. S. Naval Research Laboratory. Sept., 1943. Report PB 109323. 11 pp. Available from Library of Congress Publication Board Project, Washington 25, D. C. Microfilm $1.75, Photostat $2.50.*

Coatings

OPTICS OF PAINTS. SECOND REPORT; SPECTRAL REFLECTIVITY OF COMMERCIAL INFRA-RED REFLECTING PAINTS TO 2.5 MICRONS. *J. A. Sanderson and W. R. Holm. U. S. Naval Research Laboratory, Jan., 1943 30 pp. Report PB 109509.*

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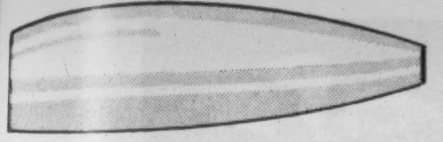

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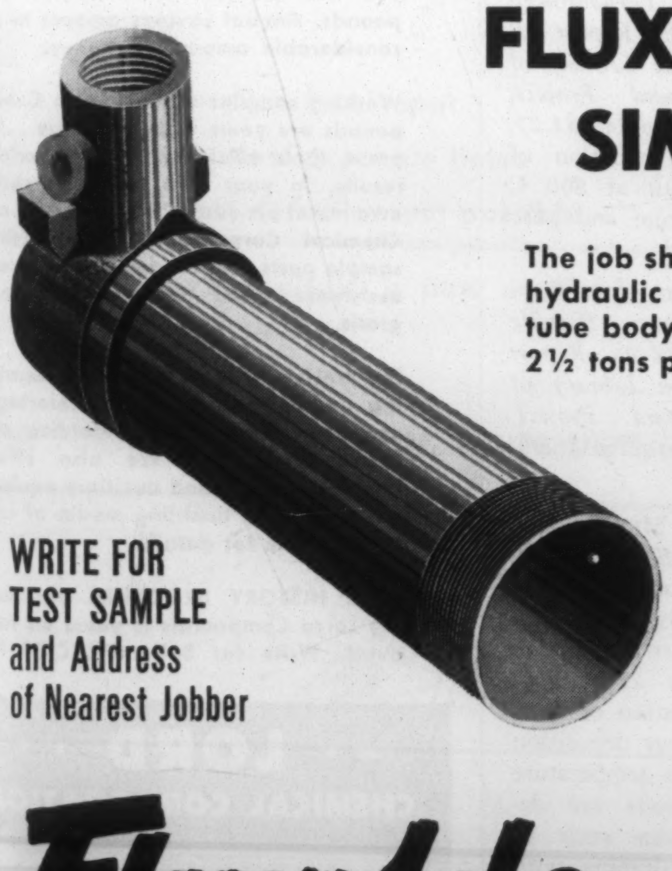

The job shown in the illustration was to sweat together the parts of an hydraulic jack consisting of a steel ram tube and a gun metal ram tube body. It was necessary to obtain a pull-strength of not less than 2½ tons per square inch. Three methods of sweat soldering were tried:

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continued from page 260

Available from Library of Congress, Publication Board Project, Washington 25, D. C. Microfilm $2.00, Photostat $3.75.

HEAT REFLECTING COATINGS FOR FLYWOOD AIRPLANES AND GLIDERS. *R. L. Benemelis and J. Leonard, U. S. Naval Research Laboratory, Jan. 1944, 33 pp. Available from Library of Congress, Publication Board Project, Wash. 25, D. C. Microfilm $2.25, photostat $5.00.* Infra-red reflecting enamels of various colors.

ANTI-FOULING PAINT STUDIES. PART II: AN INVESTIGATION OF THE INHERENT ERRORS IN LEACHING RATE MEASUREMENTS. *J. B. Ballentine, W. H. Stewart, A. L. Alexander. U. S. Naval Research Laboratory, Jan., 1946. 43 pp. Report PB 109506. Available from the Library of Congress, Publication Board Project, Washington 25, D. C. Microfilm $2.50, Photostat $6.25.*

FLEXIBLE ANTI-FOULING PAINTS ADAPTABLE TO IMMERSED RUBBER COMPONENTS. *A. L. Alexander. U. S. Naval Research Laboratory. Dec., 1944. 26 pp. Report PB 109508. Available from the Library of Congress, Publication Board Project, Washington 25, D. C. Microfilm $2.00, Photostat $3.75.* Experiments in the development of elastic underwater paints adaptable to rubber surfaces.

OXIDATION TESTS ON NICKEL PLATED TITANIUM, *D. A. Sutcliff. Great Britain Royal Aircraft Establishment, Farnborough England, 1950. 4 pp. graphs, Report PB 108808. Available from the Library of Congress, Publication Board Project, Washington 25, D. C. Microfilm $1.25, Photostat $1.25.* Rate of oxidation of nickel plated titanium in air at 800 C compared to unplated titanium and pure nickel.

SUBSTITUTES FOR TIN COATINGS ON COPPER WIRES, FINAL REPORT. *Battelle Memorial Institute, 1948. 158 pp., Report PB 109472. Available from Library of Congress, Publication Board Project, Washington 25, D. C. Microfilm $6.00, Photostat $20.00.*

VAPOR DEPOSITION OF METALS ON CERAMIC PARTICLES. *J. E. Cline, J. Wulff, Massachusetts Institute of Technology, 12 pp. Report PB 109028. Available from Library of Congress Publication Board Project, Washington 25, D. C. Microfilm 109028.* Investigation of coating ceramic particles by vapor deposition for the production of high temperature metal-ceramic bodies. Methods are described for coating ceramics such as silica, silicon carbide and alumina with molybdenum and nickel.

General

FAILURE OF ELECTRONIC EQUIPMENT UNDER TROPICAL SERVICE CONDITIONS. *J. M. Leonard. U. S. Naval Research Laboratory. 10 pp. Report PB 109521.*

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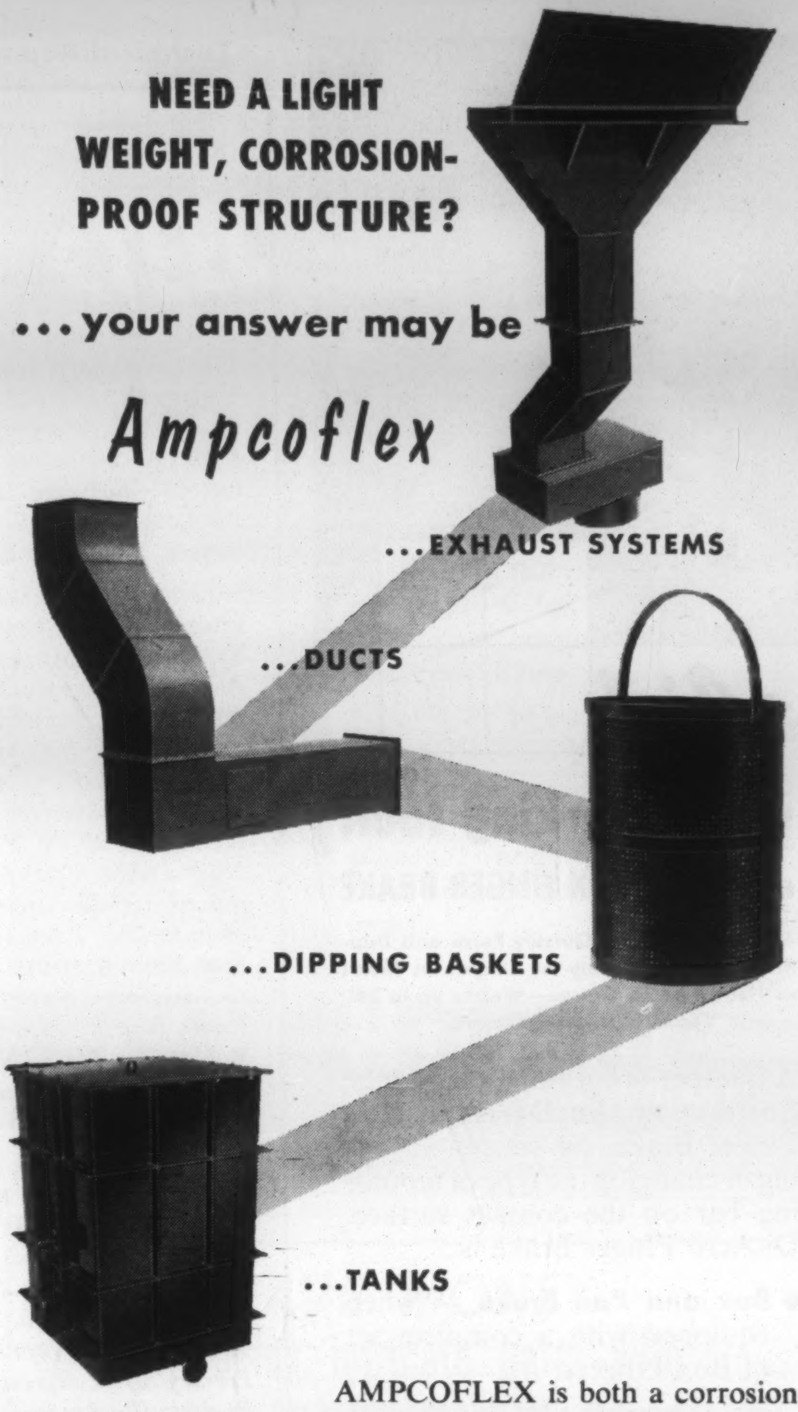

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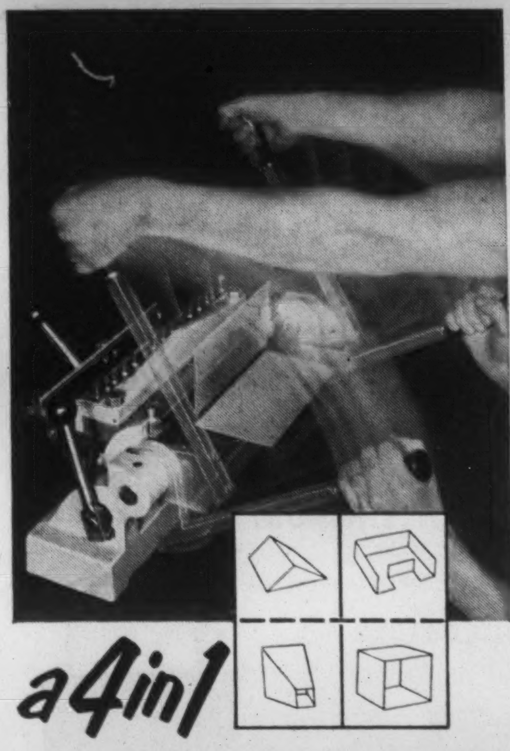

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Technical Reports . . .

continued from page 262

Available from Library of Congress Publication Board Project, Washington 25, D. C. Microfilm $1.25, Photostat $1.25. Limited supply available from Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. for $.25. A discussion of the environmental factors which are largely responsible for the failure of electronic equipment in the tropics. Corrective measures are described.

SELECTED GOVERNMENT RESEARCH REPORTS VOL. 6: STRENGTH AND STRENGTH TESTING OF MATERIALS. *Great Britain Ministry of Supply.* PART I: THEORETICAL PAPERS ON STRENGTH AND DEFORMATION. *1952, 266 pp., photos, drawings, graphs and tables. Available from British Information Services, 30 Rockefeller Plaza, New York 20, N. Y. $11.00. S. O. Code No. 47-166-6-1.* Contents include 13 reports on the strength and deformation of materials. PART II: TESTING METHODS AND TEST RESULTS. *1952, 257 pp., photos, diagrams, graphs and tables. Available from British Information Services, 30 Rockefeller Plaza, New York 20, N. Y. $11.00.* Contents include 16 reports on testing methods and results selected from 1952 publication.

SOME APPARATUS FOR MELTING REACTIVE ALLOYS WITH HIGH MELTING POINTS. *Sutcliff, Forsyth, and Bickerdike. Great Britain Royal Aircraft Establishment, Farnborough, England. 1950, 16 pp., Report PB 108809. Available from Library of Congress, Publication Board Project, Washington 25, D. C. Microfilm $1.75, Photostat $2.50.* A small arc furnace for titanium and titanium base alloys. Effect of melting on some mechanical properties of titanium. Appendix: Hardness testing of titanium.

PROCESS OF DEFORMATION AND WORK-HARDENING UNDER FATIGUE STRESSES. *Forsyth, Great Britain Royal Aircraft Establishment, Farnborough England. 1951. 18 pp. Report PB 109302. Available from Library of Congress, Publication Board Project, Washington 25, D. C. Microfilm $1.75, Photostat $2.50.*

PROPERTIES OF ELECTRICAL INSULATING MATERIALS AND METHODS OF TEST. *Great Britain National Physical Laboratory, Aerodynamics Division. 1952, 23 pp. Available from British Information Services, 30 Rockefeller Plaza, New York 20, N. Y. $.35.*

ANIMAL FATS IN HOT DIP TINNING. *Fochtman, Kinney, Ference, Riemenschneider, Morris and Ault. U. S. Bureau of Agriculture and Industrial Chemistry, Eastern Regional Research Laboratory, Philadelphia, Pa., and Armour Research Foundation, Chicago, Ill. April 1953. 18 pp. tables. Available from U. S. Department of Agriculture Eastern Regional Research Laboratory, Philadelphia 18, Pa.* Substitution of animal fat for palm oil in tinplating.

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Tells spot temperatures instantly in heat-treating furnaces, kilns forgings and fire boxes. No thermocouples, lead wires or accessories needed! Temperature indicated on direct-reading dial at a press of the button. Any operator can use it. Two double-ranges for all plant needs. Write for FREE Catalog No. 100.

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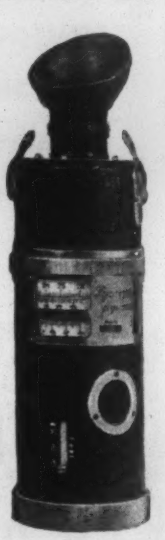

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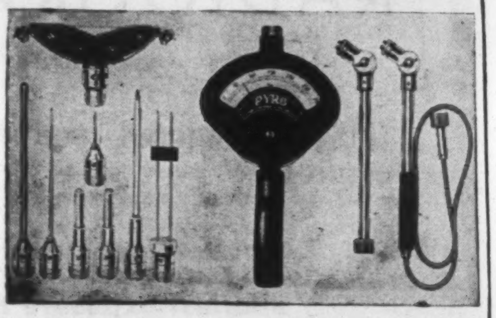

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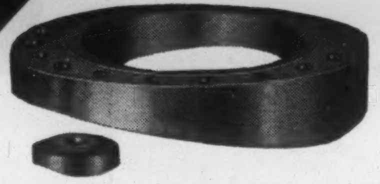

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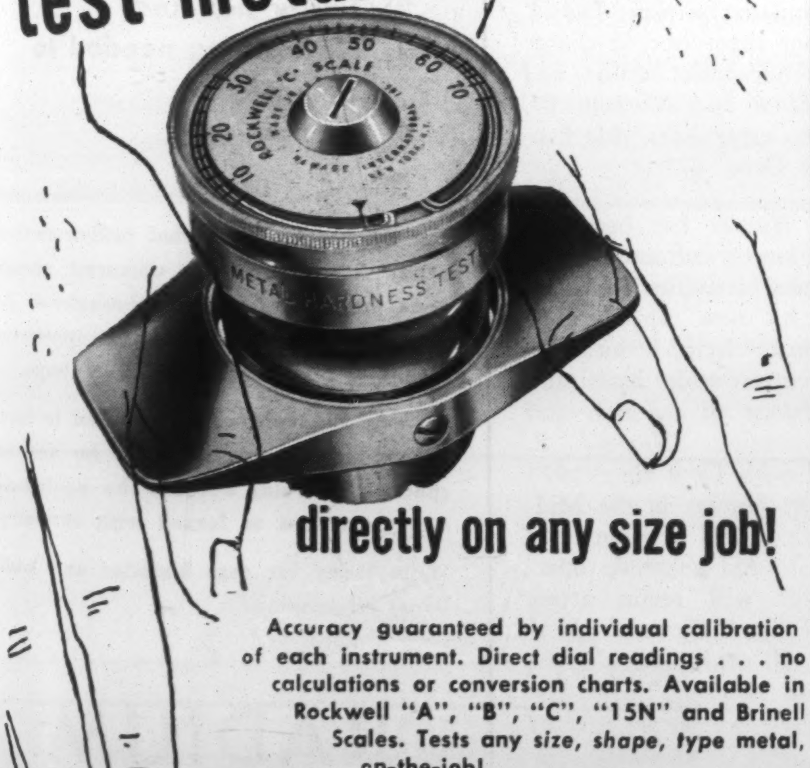

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A tarpaper background was placed four feet beyond the wire fence for this comparison test. The nearest gun contains Roylac. Roylac Aluminum dries in motion within four feet of the gun, falling away as a cottony, non-adherent powder.

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News of Engineers

Ralph D. Parker has been elected president of Canadian Nickel Co., Ltd., International Nickel Co. subsidiary which conducts its exploration and prospecting program.

Dr. Walter A. Donohue has been elected to the staff for research in chemical engineering problems at the Edison Laboratory.

O.K. Irgens has been appointed development and service chemist at Hanson-Van Winkle Munning Co.

Charles H. Commons, Jr. has joined Foot Mineral Co.'s Research and Development Dept. as head of the Ceramic Div.

Leslie L. Hotsenpiller has been elected vice president for manufacturing of National Radiator Co. Mr. Hotsenpiller has been director of manufacturing since 1952.

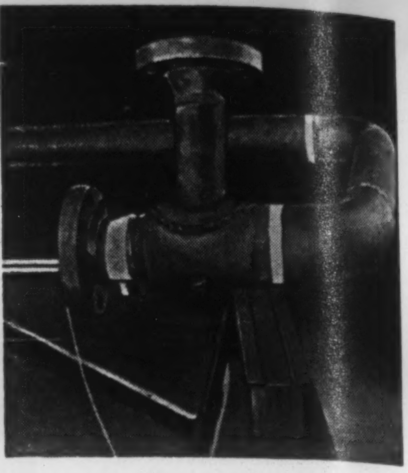
Election of *Herman L. Weckler* as vice president, operations, of Clevite Corp. has been announced.

Henry J. Barten and *Dr. Eric F. Lype* have been promoted to senior engineers in the Propulsion and Structural Research Dept. at Armour Research Foundation, Illinois Institute of Technology. Other appointments at the Foundation include *John T. Kirkland* as assistant supervisor in charge of the missiles section; *Leo A. Schmidt* as assistant supervisor in charge of the flow and aerodynamics section, and *Robert A. Rosenblum* and *Norman W. Carey* as assistant supervisors, Mechanism and Dynamics Dept.

Dr. Ralph M. Hunter has been advanced to the position of staff coordinator of all electrochemical activities for Dow Chemical Co. In his new capacity, Dr. Hunter will coordinate electrochemical operations on a company-wide basis and facilitate the exchange of research and development information. *Howard E. Houser*, associated with Dow since 1927 and assistant to Dr. Hunter in the Midland Div., has been named division head of chlorine, graphite and ammonia operations. Dr. Hunter will retain active charge of the Midland Electrochemical Laboratory which will continue under the immediate direction of *Dr. Robert D. Blue*.

Two research chemists of the Corning Glass Works, will be awarded John Price Wetherill Medals by The Franklin Institute of the State of Penn. for their discovery of a revolutionary photosensitive glass process. The men are *Dr. S. Donald Stookey* and *Dr. Robert H. Dalton*.

Robert B. Glenn has been appointed plant superintendent at Taylor Fibre Co. Mr. Glenn was formerly superintendent



Use

THIS PHOTO shows radium being used to take a radium-radiograph of a weld. Placing the radium centrally in the pipe and the film on the outside (held in place by white tape) permits radiographing the entire circumferential weld with one exposure.

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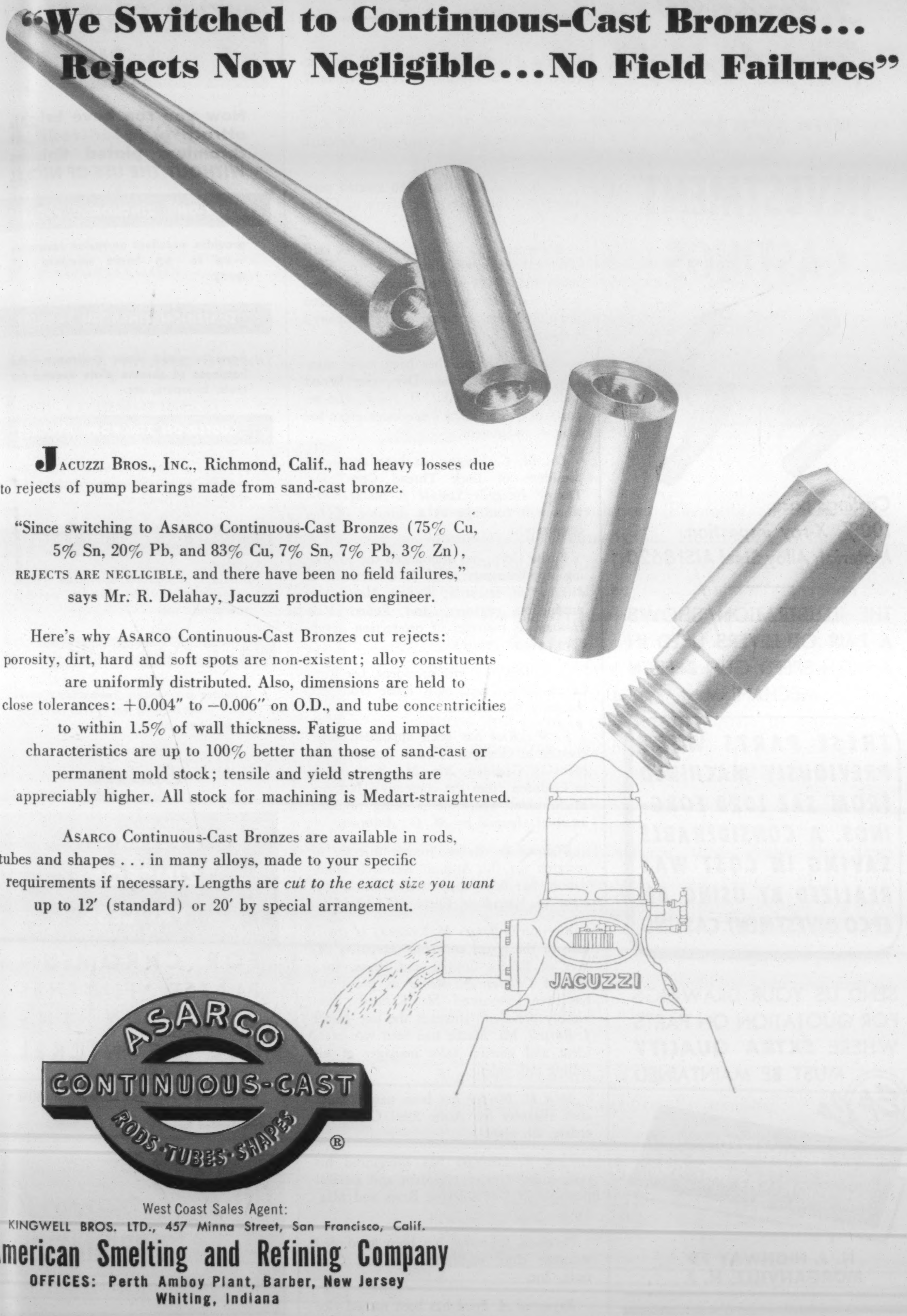

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"We Switched to Continuous-Cast Bronzes... Rejects Now Negligible...No Field Failures"

Jacuzzi Bros., Inc., Richmond, Calif., had heavy losses due to rejects of pump bearings made from sand-cast bronze.

"Since switching to Asarco Continuous-Cast Bronzes (75% Cu, 5% Sn, 20% Pb, and 83% Cu, 7% Sn, 7% Pb, 3% Zn), REJECTS ARE NEGLIGIBLE, and there have been no field failures," says Mr. R. Delahay, Jacuzzi production engineer.

Here's why Asarco Continuous-Cast Bronzes cut rejects: porosity, dirt, hard and soft spots are non-existent; alloy constituents are uniformly distributed. Also, dimensions are held to close tolerances: +0.004" to −0.006" on O.D., and tube concentricities to within 1.5% of wall thickness. Fatigue and impact characteristics are up to 100% better than those of sand-cast or permanent mold stock; tensile and yield strengths are appreciably higher. All stock for machining is Medart-straightened.

Asarco Continuous-Cast Bronzes are available in rods, tubes and shapes . . . in many alloys, made to your specific requirements if necessary. Lengths are *cut to the exact size you want* up to 12′ (standard) or 20′ by special arrangement.

ASARCO
CONTINUOUS-CAST
RODS·TUBES·SHAPES ®

West Coast Sales Agent:
KINGWELL BROS. LTD., 457 Minna Street, San Francisco, Calif.

American Smelting and Refining Company
OFFICES: Perth Amboy Plant, Barber, New Jersey
Whiting, Indiana

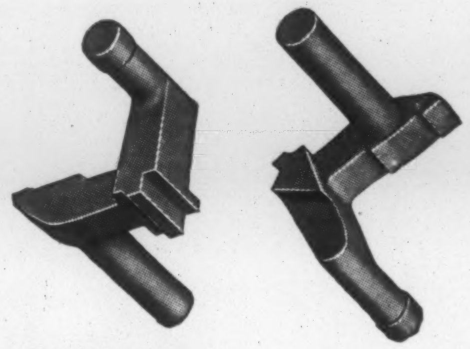
For more information, turn to Reader Service Card, Circle No. 380

For more information, Circle No. 437

Forgings Replaced

WITH EpCo

INVESTMENT CASTINGS



Castings pass
100% X-ray inspection.
Material: Alloy Steel AISI 8620

THE ILLUSTRATION SHOWS A PAIR OF LEVERS USED IN A HIGH-SPEED GUN BREECH MECHANISM

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ENGINEERED PRECISION CASTING CO.

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MORGANVILLE, N. J.

News of Engineers

of the Phenol Dept. and will be succeeded in that capacity by *Fred O'Connell.*

Dr. Aron Wexler has been appointed manager of the Magnetics and Solid State Physics Dept., Westinghouse Research Laboratories.

L. B. McKnight has been elected president and chief executive officer of Chain Belt Co.

Retirement of *Edgar L. Bailey* as staff electrical engineer, Chrysler Corp., after more than 23 years of service has been announced. *Edward D. Heins* has been appointed chief engineer of the company's Export Div.

Mark L. Shepard has been made manager of the Richmond Div., Gar Wood Industries to succeed *J. B. Steed*, who reports to the company's executive office for a new assignment.

Dr. M. C. Teague has been appointed president of Lock Thread Corp. Dr. Teague succeeds *Samuel J. Metzger, Jr.* who will continue as a director of the corporation.

Fusite Corp. has announced the following appointments: *Val J. Cichowski* as director of research; *Robert Masters* as production engineer, and *Robert Van Houten,* as manager of production development and control.

O. S. Dollison, vice president, Lee Rubber & Tire Corp., will retire from the company this month.

E. W. Kiel has been appointed chief chemist at Goodyear Tire & Rubber Co.'s plant in Gadsden, Ala. Mr. Kiel moves to Gadsden from the company's Jackson, Mich. plant where he is being replaced as chief chemist by *M. G. Atkinson.*

William E. Mahin, former director of research for the Armour Research Foundation, has been appointed technical director of Vanadium Corp. of America.

Election of *James M. Kennedy* as chairman of the board and chief executive officer of Revere Copper and Brass, Inc., and of *Charles A. Macfie* as president, has been announced. Mr. Kennedy, previously president, succeeds the late *James J. Russell.* Mr. Macfie had been vice president and general sales manager of all rolling mill sales.

John H. Harper has been named chief staff engineer for Acme Steel Co.'s Riverdale, Ill. plant.

Leon P. Disinger has announced his resignation as vice president and general manager of The Buckeye Brass and Mfg. Co.

Frank S. Schindler has been appointed assistant chief engineer of Fluid Controls, Inc.

Raymond A. Frick has been named vice

For more information, Circle No. 516

There's still a NICKEL SHORTAGE! — BUT

Now you can have bright, attractive, wear-resistant chromium plated finishes *WITHOUT THE USE OF NICKEL*

LUSTER-ON® ZINCROME® PROCESS*

provides *excellent corrosion resistance* — up to 50 hours standard salt spray

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LUSTER-ON ZINCROME PROCESS

provides *accepted brilliant finish* — for outside wear exposure required for automotive trim, etc.

LUSTER-ON ZINCROME PROCESS

provides *economical operation* — high, rugged quality at lowest possible operating cost

LUSTER-ON ZINCROME PROCESS

provides *a precisely controlled "package" process* — 10 easy-to-follow, easy-to-use steps.

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FOR CHROMIUM PLATED FINISHES WITHOUT THE USE OF NICKEL

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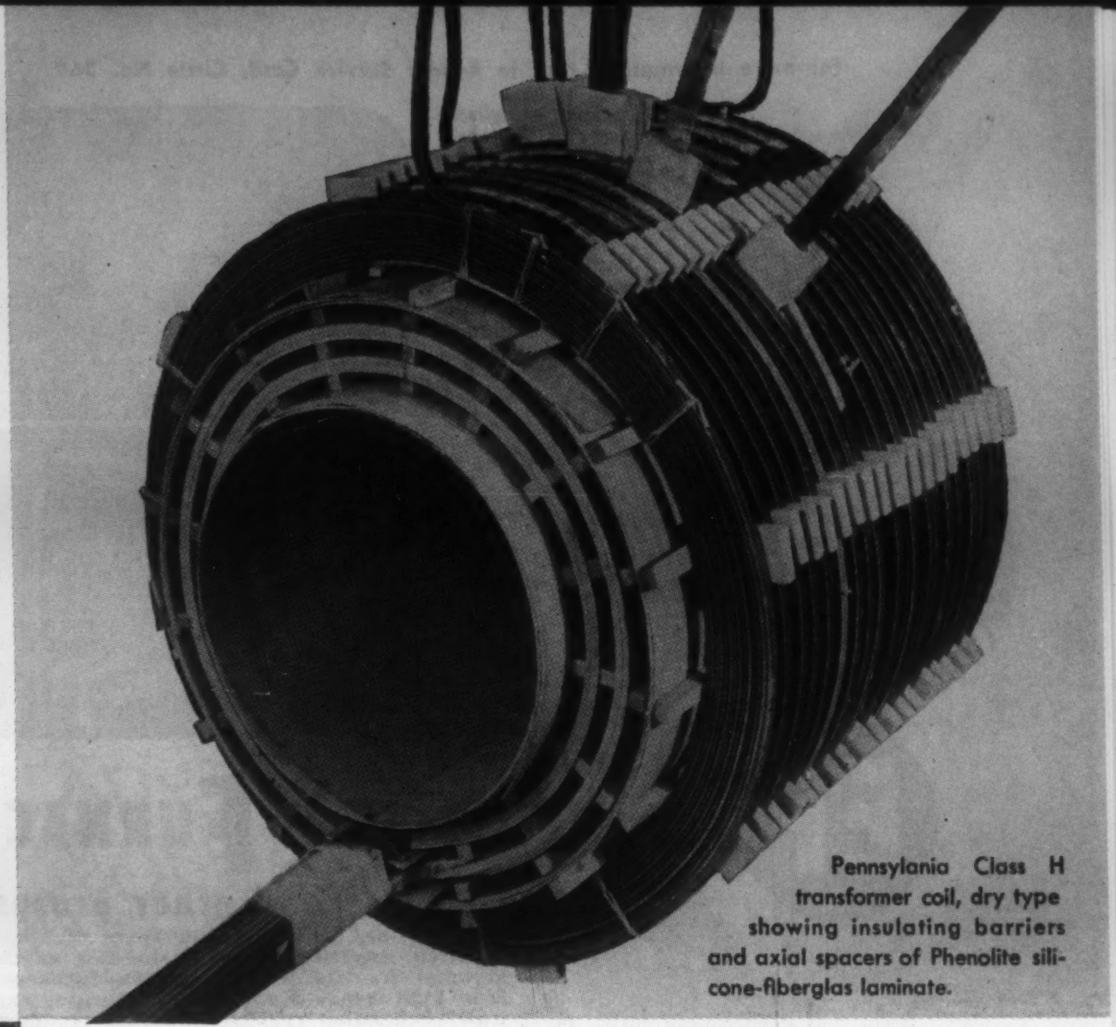
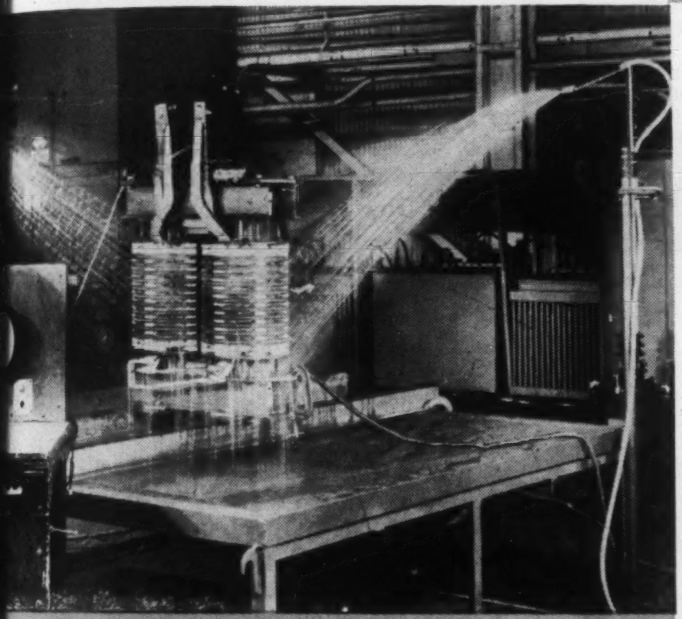
y National
Vulcanized
Fibre Co.

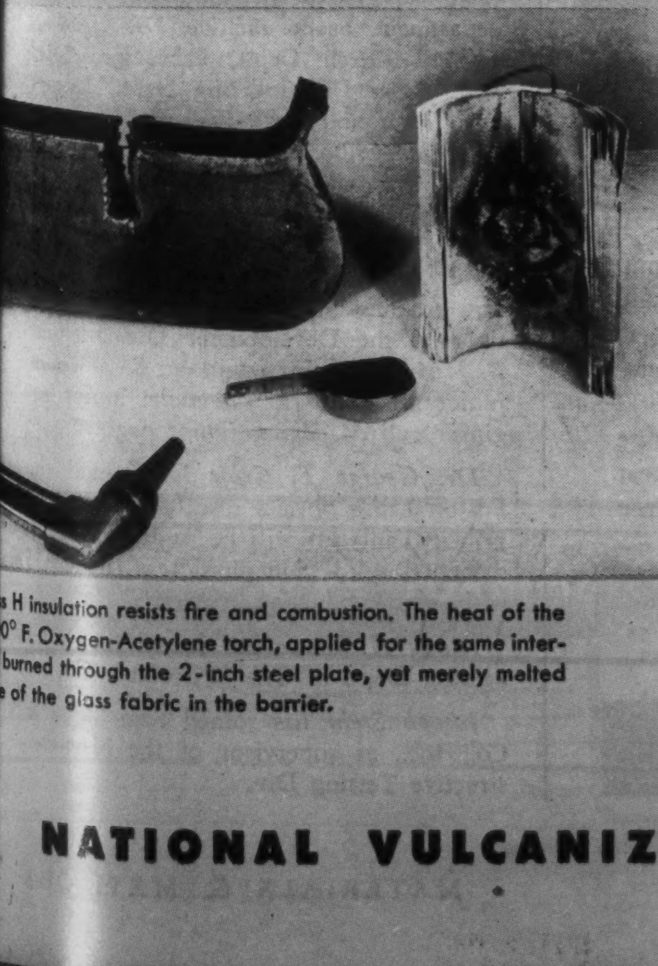
sed by Pennsylvania
Transformer Co. to build
new, safe, and reliable Sealed
Dry Type Transformers



Pennsylania Class H transformer coil, dry type showing insulating barriers and axial spacers of Phenolite silicone-fiberglas laminate.



former core and coil assembly under full voltage exon withstands heavy water shower. The insulation resistremained at infinity megohms during the entire two-hour r test.



s H insulation resists fire and combustion. The heat of the 0° F. Oxygen-Acetylene torch, applied for the same interburned through the 2-inch steel plate, yet merely melted of the glass fabric in the barrier.

Using Class H insulation (Phenolite silicone-fiberglas laminate), the Pennsylvania Transformer Company (a McGraw Electric Co. Division) builds Sealed Dry Type Transformers having many superior and safe operation features. The Class H Insulation eliminates the hazards of fire and explosion, permits up to 50 per cent weight reduction, makes possible efficient operation in humid atmosphere, reduces maintenance, allows operation at high temperatures, and permits frequent overloads. The coil barriers are made from 1/32 inch silicone sheets bonded with silicone rubber. The sheets are rolled directly onto the lathe during the coil winding operation, saving the high cost of a mandrel. Ideal for station auxiliary, unit substation and network service, these Sealed Dry Type Transformers are an outstanding example of National cooperative engineering and research. Perhaps you have an insulating problem where National Vulcanized Fibre Company can give you real help in solving your particular problem . . . economically. Write us—our engineering service is immediately available.

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nationally known—nationally accepted

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PHENOLITE
Laminated PLASTIC

NATIONAL VULCANIZED FIBRE COMPANY
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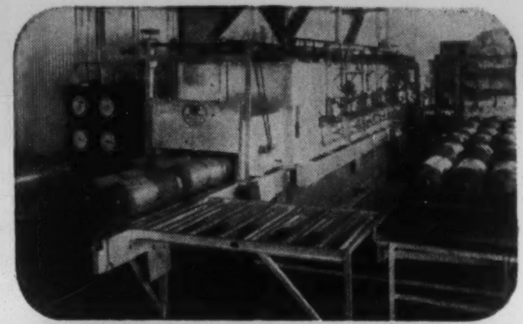
Compressed gas cylinders or tanks are continuously normalized and annealed —scale-free in EF gas fired furnaces.



Bolts, springs and other products are scale-free heat treated in EF continuous chain belt conveyor furnaces. 11 sizes —to handle from 125 to 2000 lbs. or more per hour.

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DRAWING
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GALVANIZING
HARDENING
HOMOGENIZING
MALLEABLIZING
NORMALIZING
NITRIDING
SINTERING
SOLUTION TREATING
STRESS RELIEVING
STRIP— ANY PROCESS
SPECIAL ATMOSPHERE TREATMENTS AND OTHER PROCESSING

EF PRODUCTION FURNACES

for these and other processes

● Reflecting more than 30 years of continuous research, experience and outstanding engineering accomplishments, EF production furnaces combine high heating efficiency—accurate, automatically controlled cycles—high fuel economy—and produce products with uniform physicals and surface finish year after year.

For advanced engineering designs that minimize maintenance and produce high hourly outputs, turn your production furnace problems over to one of the experienced EF furnace engineers—*It pays.*

EF THE ELECTRIC FURNACE CO.
GAS FIRED, OIL FIRED AND ELECTRIC FURNACES
FOR ANY PROCESS, PRODUCT OR PRODUCTION
Salem - Ohio

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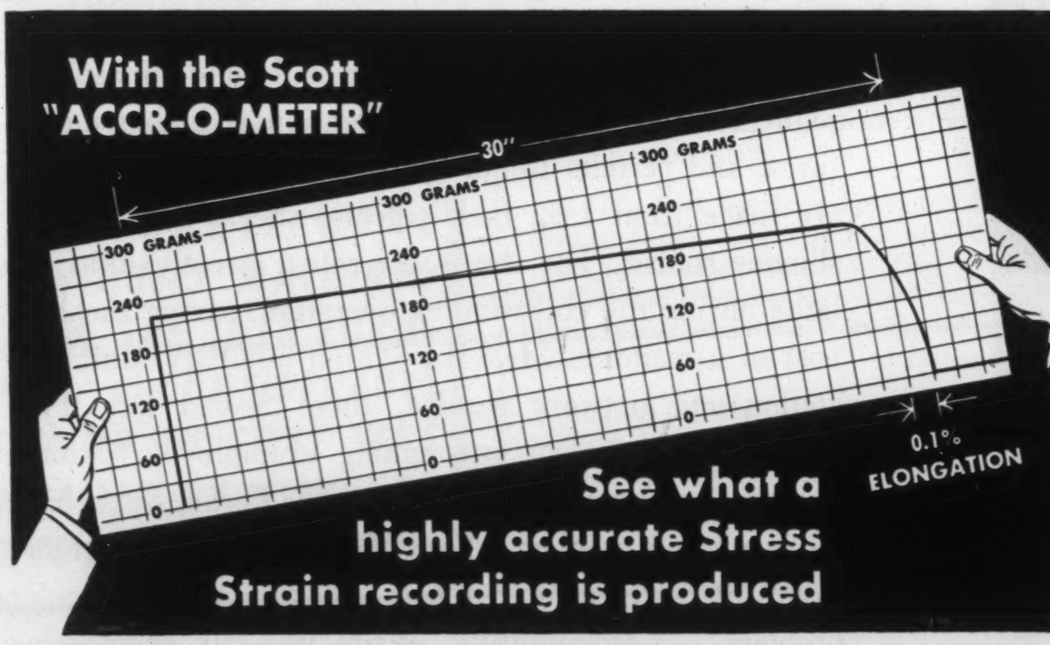
With the Scott "ACCR-O-METER"



See what a highly accurate Stress Strain recording is produced

A Scott tensile tester, equipped with "Accr-O-Meter" weighing system for constant-rate-of-extension testing, gives this large-scale picture of the material under test, whether it be plastic, rubber, wire, fabric, leather, textile yarn or cord, etc. The range of this particular unit was 300 grams but with slight adjustment the range can be increased up to 2,000 lbs. Request details of this newest weighing system, free from inertia, accurate beyond belief.

SCOTT TESTERS, INC. 65 BLACKSTONE ST. PROVIDENCE, R. I.

Scott Testers — Standard of the World

For more information, turn to Reader Service Card, Circle No. 547

News of Engineers

president, Brake Shoe & Castings Di American Brake Shoe Co.

Appointment of *Eugene R. Perry* president of the company and its subsi iaries has been announced by Nation Vulcanized Fibre Co. Mr. Perry joine the company last year as vice presiden director, and general manager, comin from the Micarta Div., Westinghouse.

Election of *I. Melville Stein* as pres dent of Leeds & Northrup Co. has bee announced. Mr. Stein, formerly executiv vice president, succeeds *Charles S. Redding* who becomes chairman of the board

Election of *Robert L. Westbee* as a vic president of Minnesota Mining & Mfg Co. has been announced. Mr. Westbee will head 3M's newly-created Electrical Products Div.

Ivan F. Harlow, a veteran of 44 years service with Dow Chemical Co., has relinquished his position as production manager of Inorganic Chemicals, and *Grayton F. Dressel*, his assistant, has been named his successor. Mr. Harlow, who is currently president of Ethyl-Dow Chemical Co., a Dow associated company, will continue to serve as a production consultant.

Tudor A. Wall has been named manager of Kaiser Steel Corp.'s newly-created Industrial Development Dept.

Sam B. McWhorter has been appointed chemical engineer at Lithcote Corp.

Frank J. Hodnick has joined Solar Aircraft Co. as ceramic research engineer. Mr. Hodnick has been in the ceramic research field for 22 years and was formerly in charge of research and plant control at Canton Stamping and Enameling Co.

Appointment of three department heads as well as the addition of five engineers and two scientists at Walter Kidde Nuclear Labs. has been announced. The new department heads include *Dr. Cecil B. Ellis,* Research Dept., Laboratory Div.; *J. J. Byrnes*, Engineering Dept., Laboratory Div.; and *Karl Puechl*, Theoretical Dept., Development Div. Staff additions to the Laboratory Div. include: *G. Bartolomei, Sr.,* project engineer; *D. M. Benforado,* junior chemical engineer; and *C. W. Stanley*, scientist, formerly with Los Alamos Scientific Labs. Staff additions to the Development Div. include: *B. J. Byrne*, junior engineer; *S. Millman*. junior scientist; *H. Yanowitz*, junior engineer and *M. Zizza*, junior engineer.

Dr. George T. Croft has joined the Edison Lab.'s physics research group. His principal interest will be research in fundamental solid state physics as concerned with semi-conducting materials.

Albert H. Crone has joined the Engineering Dept. of The Wilcolator Co.

Joseph Stein has joined Sam Tour & Co., Inc., as supervisor of the Non-Destructive Testing Div.

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1918	W. S. ROCKWELL COM
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1937	THE CARL MAYE
1939	DESPATCH OVEN
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1940	NICHOLS ENGINEE

Thirty five years ago the Spencer Turbo was first specified by a furnace manufacturer. Since that time, the list has grown to more than thirty—all of whom are Spencer users today.

The reasons they prefer Spencer are the absolute reliability — perfect performance and low maintenance over long years of almost continuous service.

Complete information in Bulletin No. 126-A. For other industrial uses, ask for Turbo Date Book No. 107-C.

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ROCKWELL
BUILDS BETTER
FURNACES

Continuous Mesh Belt Conveyor Furnaces, with moderate width and length of belt, for medium capacity in sintering pressed ferrous and non-ferrous metal powders.

Continuous Roller Hearth Furnaces for larger capacity of pressed metal products loaded in trays.

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Cooling Sections may be provided for cooling product to any required temperature.

Provision in furnace and cooling section for sintering in protective atmosphere.

Get our recommendations to fit your requirements.

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FURNACES • OVENS • BURNERS • VALVES • SPECIAL MACHINERY

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MULTIPLE ASSEMBLIES
FOR SMALL PARTS BELONG TO
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DIE CASTINGS
GIVE YOU TINY
PARTS LIKE THESE
COMPLETE
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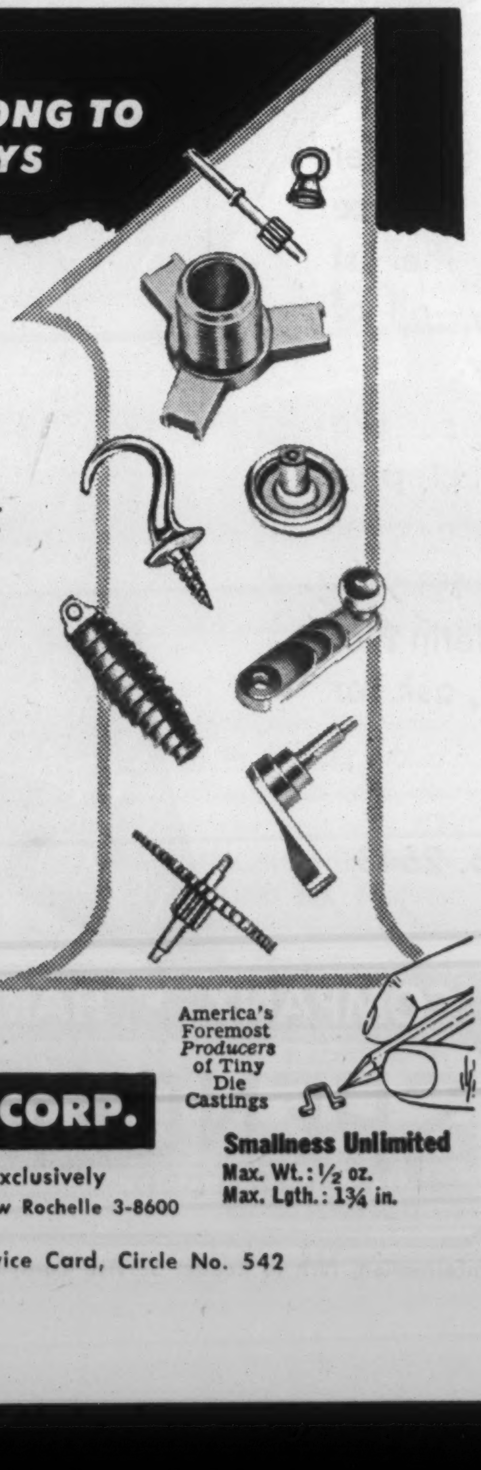
OPERATION



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Smallness Unlimited
Max. Wt.: ½ oz.
Max. Lgth.: 1¾ in.

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News of Engineers

Harold M. Greenhouse, formerly of the Ohio State University Research Foundation, has joined the Research Dept., Ferroxcube Corp. of America. Mr. Greenhouse will be employed in research on development of new types of ferrite magnetic materials.

P. L. Coddington has been appointed assistant to the president, Carpenter Steel Co., at the firm's Alloy Tube Div.

J. H. Babcock, formerly vice president in charge of development and research, has been named vice president of Hooker Electrochemical Co., and *Dr. J. H. Bruun*, formerly director of research, has been appointed director of research and development.

Jerold L. Welch has been appointed chief engineer, Reed-Prentice Corp.

J. H. Babcock has been named vice president of Hooker Electrochemical Co. and *Dr. J. H. Bruun*, formerly director of research, has been appointed director of research and development.

M. J. Hoke has been appointed to the post of general manager of Ohio Crankshaft Co.'s Crankshaft and Camshaft Div.

Acme Steel Co. has announced the appointment of *Stephen Rasul* as manager of design and production engineering for the company's Riverdale plant.

Brooks & Perkins, Inc. has announced the following appointments: *Charles D. Smith* as works manager of the company's Mill Div. and *Edward H. Perkins* as manager of the newly created Commercial Div.

U.S. Steel recently broke ground near Pittsburgh for construction of a new research center devoted to the development of new processes for making better steel. The new laboratory, it is expected, will serve to coordinate all of the company's technological development programs.

Aeroquip Corp. has recently added to its operating and storage facilities with the purchase of the *Sterling Electric Motors* plant in Van Wert, Ohio.

Died.....

John Howe Hall, 72, dean of foundry engineers. Mr. Hall was instrumental in developing heat treatment of steel for use in cast armor. Author of "The Steel Foundry" and a former member of the editorial advisory board of *Metals and Alloys*, he was a constant contributor to steel foundry literature and was considered one of the outstanding authorities in the field.

L. M. Kliendienst, retired vice president and member of the board of The Timken Roller Bearing Co.

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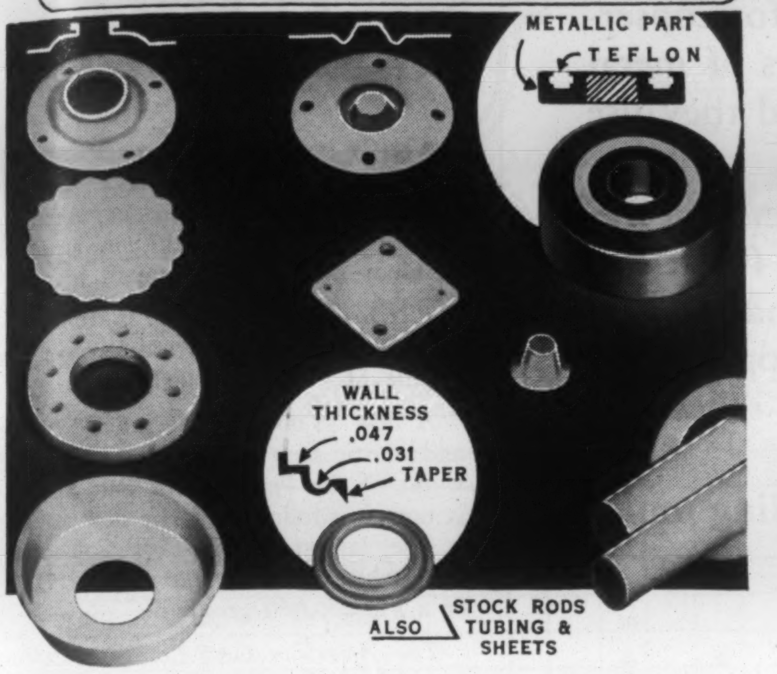
GOT A TOUGH ONE IN
TEFLON?
CONTACT SPARTA, SPECIALISTS IN TEFLON MOLDING



Above, some recent Teflon moldings by Sparta. Represented are Diaphragms, Special Washers, Discs, Seals and Cup Seals with difficult undercuts, varying wall thicknesses, other physicals formerly thought impossible to mold in Teflon.

Perhaps YOU can improve products, processes and profits with Teflon MOLDED TO YOUR SPECIFICATIONS. Sparta offers painstaking cooperation, no obligation . . . just write or call

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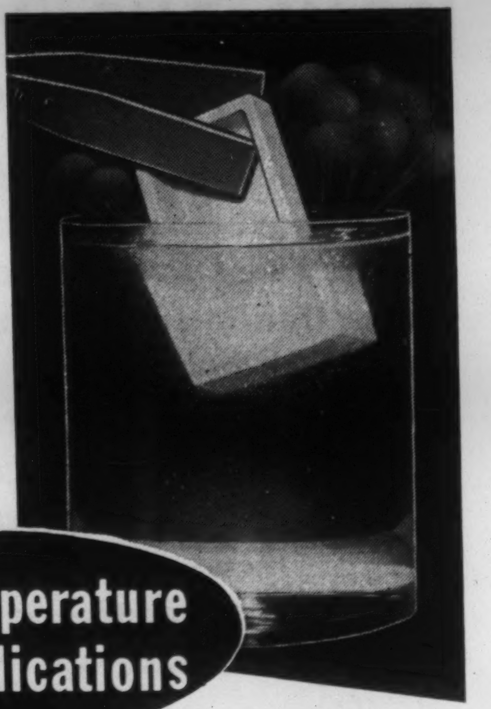
WESGO
CRACK-PROOF
CERAMIC
BOATS



for high temperature furnace applications

- Extremely high resistance to thermal shock
- Variety of stock sizes; also available in special shapes to specifications
- Retain shape, stay flat in service
- Unaffected by furnace atmospheres
- Inert to virtually all metals

Boat at 2000° F. plunged into ice water does not crack.

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that we now manufacture and sell

Offset
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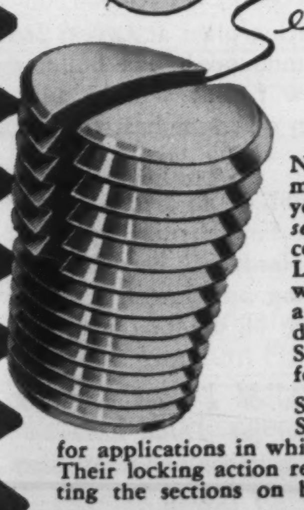
—formerly marketed by
Shakeproof Division of
Illinois Tool Works



Now, more than ever, you can make Set Screw & Mfg. Co. your No. 1 source of supply for *self-locking set screws.* The recent addition of Offset Type Self-Locking Set Screws to our own widely successful ZIP-GRIP* and NU-CUP Self-Locking designs gives you a complete Self-Locking Set Screw range for solving vibration problems.

Setko Offset Self-Locking Set Screws are particularly suited for applications in which slotted screws are required. Their locking action results from springing or offsetting the sections on both sides, parallel with slot.

Write for new catalog sheet on Setko Offset Self-Locking Set Screws.

*Pat. Pending

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Simply write your name and address on margin of this page, tear out and mail today.

149 Main St., Bartlett, Ill. (Chicago suburb)

We Specialize in Solving Puzzling Set Screw Problems

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. . . are available for standard or specially developed POWDERS to meet your requirements

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HOW THE WROUGHT BRASS INDUSTRY CONSERVES METAL

No industry melting *commensurate tonnage** of vital metal can quite match the brass mills for conservation and low melting losses. The savings of metal total millions of pounds; clearly the method they use is worth noting:

Virtually all the brass mills in North America use the Ajax-Wyatt induction melting furnace, for it has the lowest metal losses in the field—less than 1%—with superior temperature control and unapproached economy of operation on high production schedules such as we have today.

The accepted melting tool in brass rolling mills throughout the world.

** Upwards of 5 billion pounds annually.*

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ASSOCIATE COMPANIES:
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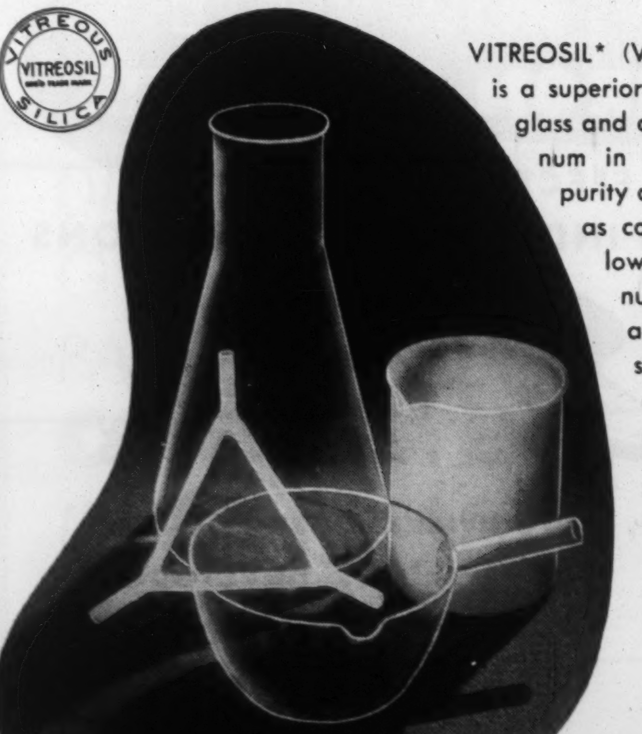
AJAX ELECTRIC COMPANY, INC., *The Ajax-Hultgren Electric Salt Bath Furnace*
AJAX ENGINEERING CORPORATION, *Ajax-Tama-Wyatt Aluminum Melting Induction Furnaces*

FOR EXACTING LABORATORY USE

VITREOUS VITREOSIL SILICA



VITREOSIL* (Vitreous Silica) laboratory ware is a superior replacement for porcelain and glass and a satisfactory substitute for platinum in many cases. Greater chemical purity and high resistance to heat shock as compared to other ceramics and low initial cost compared to platinum have led to the universal adoption of VITREOSIL as a substitute for platinum, porcelain and other materials in many analytical procedures.

Standard items of VITREOSIL Laboratory Ware include transparent, glazed and unglazed crucibles, evaporating dishes, beakers, tubing, etc.

Large stock enables prompt shipment.

Write for Technical Bulletins giving full descriptions, specifications, and prices.

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For more information, turn to Reader Service Card, Circle No. 473

News of Companies

Cramet Inc., a wholly owned subsidiary of *Crane Co.*, has contracted with the Defense Materials Procurement Agency to construct a plant for the production of titanium sponge and titanium ingots.

Electro-Nite Carbon Co. is constructing a new plant at Torresdale Ave. and Strahle St., N.E. Philadelphia.

A new $8,000,000 electrolytic chlorine and caustic soda plant at the Calvert City works of the Pennsylvania Salt Mfg. Co. is now in production. The new structure is the largest single expansion project undertaken by the company and is part of a $12,000,000 program.

The American Cam Co. has just completed transferral to its new quarters at Bloomfield, Conn. The recently completed building will house the company's general offices, drafting room, and inspection department. Mailing address of the company will remain the same.

General Electric Co. has announced the formation of two new departments, a *Specialty Transformer Dept.* and a *Ballast Dept.* Another step in the company's decentralization program, the move divides the former *Specialty Transformer and Ballast Dept.* in two separate organizations.

Creation of the *Engine Div.*, a new major component of the company, has been announced by *Caterpillar Tractor Co.*

Chain Belt Co. has announced the purchase of *Shafer Bearing Corp.* for the purpose of broadening the markets for its power transmission products. The new addition will operate as the *Shafer Bearing Div.*, Chain Belt Co.

Plans to build a $10,500,000 armor plate producing plant at *Lukens Steel Co.*, have been announced. The building housing the new facility will be adjacent to the company's present heat treating plant.

Foster D. Snell, Inc. has announced the formation of an *Engineering Physics Dept.* in the Engineering Div. of the firm. Walter L. Hardy has been made director of engineering, and Joseph P. McGill will be in charge of the Engineering Physics Dept.

Dedication of a new $2,600,000 research center at *Dow Chemical Co.'s Texas Div.* in honor of Dr. William Reed Veazey, recently retired Dow director and research consultant, has been announced.

Rectifier Corp. of Puerto Rico has begun operations in a new plant located in Fajardo. The new company has been incorporated under the Island's laws to manufacture selenium rectifiers and related electronic equipment.

Continental Can Co., in a step to round

For Your High-Purity Process Needs...

Specify FINE and SPECIAL CHEMICALS

The following are but a few of the many B&A Fine Chemicals available in tonnage quantities for high purity process use. They are charted to indicate some of the major industries in which they are used.

CHEMICAL	INDUSTRY																				
	Battery	Chemicals	Dyes & Intermediates	Electronics	Explosives	Food	Glass & Ceramics	Iron & Steel	Leather	Metal Fabricating & Finishing	Mining & Metallurgy	Oil Refining & Petroleum	Paints & Pigments	Pharmaceuticals	Photography	Plastics & Resins	Pulp & Paper	Rubber	Soap & Detergents	Textiles	Water Treatment
Acetamide		●	●											●			●				
Acid Fluoboric	●	●		●			●	●	●	●	●	●	●			●					
Acid Hydrofluoric, Reagent		●		●			●			●	●										
Alkali Fluoborates							●	●		●	●										
Aluminum Chloride, Solution		●	●			●	●		●	●	●	●	●	●	●		●	●	●	●	●
Aluminum Fluoride, Crystal		●								●		●		●							
Aluminum Nitrate		●		●								●								●	
Ammonium Acetate						●				●		●		●				●		●	
Ammonium Oxalate			●		●				●	●			●	●			●	●		●	
Ammonium Sulfate Purified and Reagent A.C.S.	●	●				●	●		●	●				●		●	●			●	
Ammonium Thiosulfate				●					●	●				●	●					●	
Boron Trifluoride Gas and Various Complexes		●								●	●	●	●	●		●		●		●	
Cadmium Nitrate	●	●		●			●					●	●			●					
Calcium Acetate Purified and Reagent		●				●							●	●		●		●	●		
Calcium Chloride, Anhydrous Purified and Reagent A.C.S.				●		●										●					
Calcium Phosphide					●						●										
Chlorine Trifluoride		●														●					
Chromium Fluoride		●	●							●			●							●	
Chromium Nitrate		●														●					
Chromium Potassium Sulfate (Chrome Alum)		●	●						●					●	●		●			●	
Cupric Nitrate		●	●		●			●		●					●					●	
Cuprous Chloride	●	●	●		●						●	●	●	●		●				●	
Ferric Nitrate			●						●											●	
Ferrous Ammonium Sulfate		●	●							●								●			
Lead Nitrate		●	●		●				●		●	●	●	●	●		●		●	●	
Metal Fluoborates										●						●					
Oxamide					●																
Potassium Acetate		●		●					●	●				●		●	●			●	
Potassium Bifluoride		●		●			●			●										●	
Potassium Borate, Tetra										●											
Potassium Fluoride		●								●											
Potassium Nitrite		●	●			●				●		●						●	●		
Potassium Permanganate																					●
Potassium Titanium Fluoride											●							●			
Sodium Bisulfite, Meta Purified and Reagent						●									●					●	
Sodium Fluoride, Reagent A.C.S.								●						●							
Stannous Chloride		●	●					●	●	●				●					●	●	
Sulfur Hexafluoride				●																	

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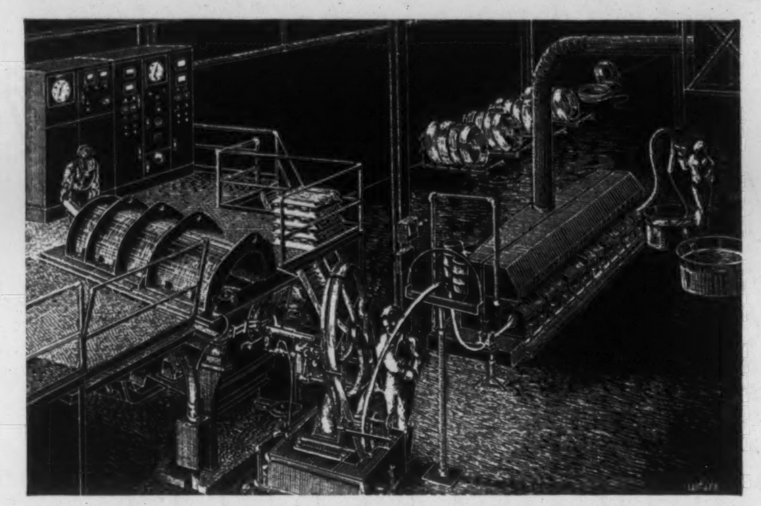

ROME CABLE CORPORATION
uses
AJAX
INDUCTION FURNACES
for
melting aluminum for continuous casting of high conductivity rod

The picture above, a drawing made at the Rome Cable Corporation, Rome, N. Y., shows one of the most modern installations in the country for the continuous casting and rolling of aluminum rod directly from molten metal. From left to right are shown the electric controls of the adjacent 450 kW. AJAX low frequency induction combined melting and holding furnace which is pouring molten metal into the Properzi continuous casting machine in the foreground, and the rolling mill from which the coiled rod is emerging.

This installation casts at the rate of about one ton per hour. The furnace feeds a continuous stream of molten aluminum at automatically controlled temperature into a rim cavity on the slowly revolving wheel of the Properzi machine. Metal loss from pig to rod averages less than 1 pct. Mechanical properties and electrical conductivity are excellent; the material is sound and fine grained. The men work under cooler, cleaner conditions because the only heat generated is within the melt itself. Due to melting conditions inherent in AJAX furnaces, the operation is continuous and no fluxing is required.

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AJAX ELECTRO METALLURGICAL CORP., and Associated Companies
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AJAX ELECTRIC CO., INC., The Ajax Hultgren Electric Salt Bath Furnace
AJAX ELECTRIC FURNACE CORP., Ajax Wyatt Induction Furnaces for Melting

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News of Companies

out its diversification in the packaging field, has purchased all the outstanding stock of the *Elmer E. Mills Corp.*

U. S. Rubber Co. has formally opened its new Denver branch at 4800 Colorado Blvd. Built to serve the rapidly expanding markets in the Rocky Mountain area, comprising all of Colorado and parts of nine other states, the branch represents four major divisions of the company.

Enthone, Inc. has completed interior and exterior work on its new office building.

General Electric Co. will build a $5,000,000 plant at Bloomington, Ill., to manufacture general purpose controls for industrial use.

Purchase of *Irvington Varnish & Insulator Co.* by *Minnesota Mining & Mfg. Co.* has been announced. Irvington will now operate as a division of 3M.

Stalwart Rubber Co. has announced purchase of *Jasper Rubber Co.* The acquisition of the new plant involves one-half million dollars and is another step in the company's expansion program.

Substantial addition to the country's supply of glycerine and Epon resins will result from a new *Shell Chemical* plant to be erected at Norco, La. Completion is scheduled for late 1954.

A metal-working lubricant school to provide instruction in wax lubricants has been established by *S. C. Johnson & Son, Inc.* The school was created to train salesmen of the company's distributors in the fundamentals of wax chemistry and in the use of Johnson's new wax cutting fluids and lubricants.

Columbia-Southern Chemical Corp. will enter the ammonia production field with plans to construct its first ammonia producing facility soon at Natrium, W. Va. Contracts for the construction work will be let in the near future, and the firm expects production to begin by late 1954.

United States Diamond Wheel Co. has completed its new Aurora, Ill. plant.

Cyril Bath Co. recently opened its new $2,000,000 plant in Solon, Ohio.

Mannesmann Works, Germany, has combined with one of the world's leading seamless tube mill machine manufacturers, *Maschinenfabrik Meer A. G.,* to form a new company in this country, *Mannesmann-Meer Engineering & Construction Co.* in Easton, Penna. The new firm will offer a complete line of seamless tube mill machinery as well as hydraulic equipment and other special mill machinery for the steel, copper, brass, aluminum, and other branches of the metal working industry. Officers of the new company are: Dr. K. Gruber, chairman of the board; Dr. Gerhard Wagner, president; A. L. Thurman, executive vice president; John

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(3) *Quick and courteous service means less follow-up time and annoyance on customer's part,—and of course, more prompt deliveries to our customers' customers.*

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Note: Our new, flat opening, flexible-bound "Reference Book on Bronze Casting Alloys" has just come off the press—copy will be sent upon request on your Business Letterhead.

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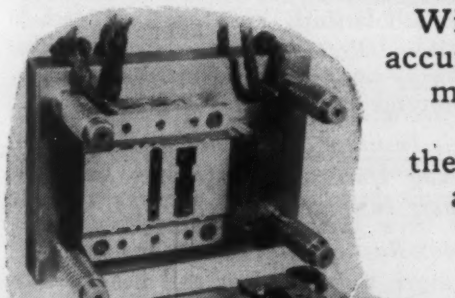

With amazing speed and accuracy, the hardest man-made metals can now be machined. Some of the work now being done at Arc Machining, Inc. includes machining of carbide dies; finish machining after final heat treatment where distortion presents a problem; corrective machining of hardened parts; die revisions; drilling small holes in stainless steel tubing, etc. without burrs. These and many more applications of "arc machining" are saving specification and process engineers thousands of dollars each day. Send us your problem today.

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For more information, turn to Reader Service Card, Circle No. 544

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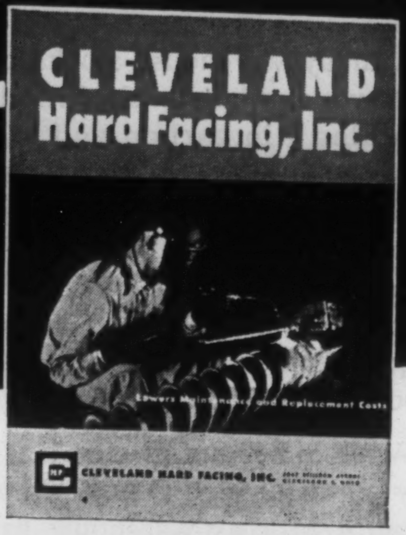

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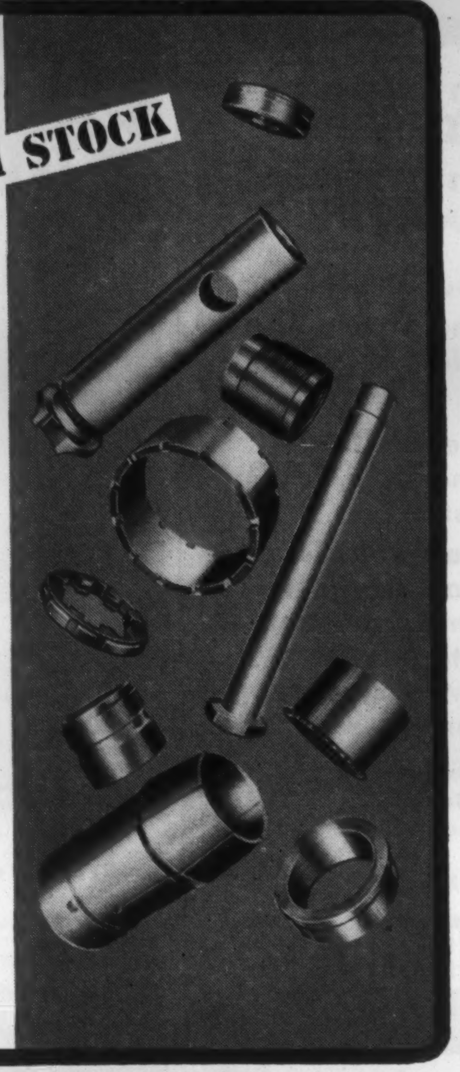

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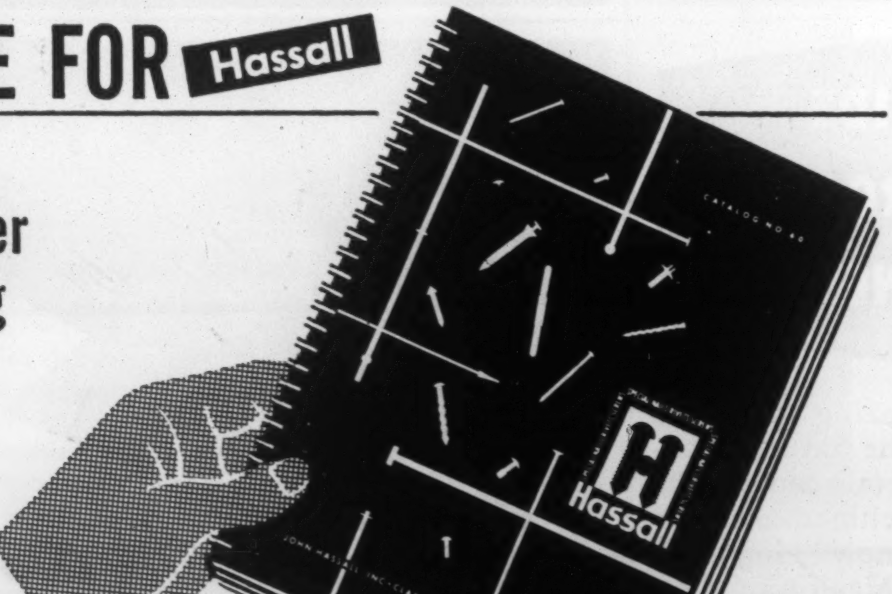
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News of Companies

D. Judge, vice president; K. Schwing, secretary-treasurer.

Construction is now underway on a new laboratory building for the *Forbes Finishes Div., Pittsburgh Plate Glass Co.* The new building will be a three-story structure adjoining the division's administration office building, 3800 W. 143rd St., Cleveland.

Continental Can Co.'s two recent acquisitions, *Benjamin C. Betner Co.* and *Shellmar Products Corp.*, have been consolidated into the company's new *Shellmar Betner Flexible Packaging Div.*

Heldor Mfg. Corp. has moved its plant and offices to 238 Lewis St., Paterson, N. J.

Indiana Steel Products Co. has been selected by the *U. S. Air Force* for a contract sponsored by the *Wright Air Development Center* of the *Air Research and Development Command* to conduct a comprehensive research program on magnetics to improve military air and ground devices utilizing magnets.

Maximum productive capacity will be upped 60% by a new addition to the Yellow Springs, Ohio plant of *Morris Bean and Co.'s* Antioch Process aluminum foundry.

Plans for a new metallurgical development laboratory have been announced by *General Electric Co.* The new facility, a part of the company's *Research Laboratory* at the Knolls, will provide more than 70,000 sq ft of floor space. It will be the eighth building of those comprising the Laboratory. The building is scheduled for completion by the spring of 1955.

National Malleable and Steel Castings Co. has established $3,000 in scholarships this year at six educational institutions. The scholarships are for $500 each at *Western Reserve University* and *Case Institute of Technology,* Cleveland; *Rose Polytechnic Institute,* Terre Haute; *Carnegie Institute of Technology;* Pittsburgh; *Purdue University,* Lafayette, Ind.; and *Illinois Institute of Technology,* Chicago.

Nox-Rust Chemical Corp. has completed its move to new plant and headquarters. The new plant is located at 47th St. and Central Ave., Chicago, and the executive and sales offices are now in a new downtown location at 333 N. Michigan Ave., Chicago.

The North American Phillips Co., Inc. will hold the fall session of its semi-annual X-ray Diffraction School at the Mount Vernon, N. Y. plant during the week of Oct. 5-9. Classroom and laboratory work is offered in fields including X-ray diffraction, new high and low temperature camera techniques, fluorescence analysis, Geiger counter x-rays analysis and electron microscopy and diffraction. No fee.

MANUFACTURERS' LITERATURE

Steel Tubing. Summerill Tubing Co., Div. Columbia Steel and Shafting Co., 8 pp, ill. Cold drawn steel tubing for hydraulic applications. (39)

Strip Steels, Etc. Superior Steel Corp., 12 pp, ill. Detailed data on the proper selection of Superior strip steels, stainless steels, SuVeneer Clad Metals, alloy and spring steels, etc. (40)

Fine Small Tubing. Superior Tube Co., 4 pp, ill, No. 32. Detailed information on Superior fine small tubing in all analyses 0.10- to ⅝-in. o.d. and in certain analyses (9.935-max wall) up to 1⅜-in. o.d. (41)

Metal and Plastic Parts. Sylvania Electric Products Inc., Parts Div., 19 pp, ill. Shows facilities for fabricating metal, wire, plastic and mica components. Also illustrates line of molded and laminated sockets. (42)

Spun Metal Parts. Roland Teiner Co., Inc., ill, No. 51D. Brochure describes this company's facilities for spinning practically any metal or gage required. (43)

Permanent Magnets. Thomas & Skinner Steel Products Co., Inc., 12 pp, ill. Alnico 2, 3 and 5 standard magnets in stock. Bars, rings, channel bars, horseshoe shapes. Tables of magnetization curves, energy curves and physical properties. (44)

Precision Casting. Thompson Products Inc., Metallurgical Products Div., 8 pp, ill, No. MP-53-1. Discusses the Intricast process of precision casting any castable metal or alloy. (45)

Graphitic Steel. The Timken Roller Bearing Co., Steel & Tube Div. Data on properties and applications of graphitic steels in Timken Graphitic Steel Data Book. (46)

Steel Forgings. Titusville Forge Div., Struthers Wells Corp., 8 pp, ill. Describes facilities for precision forging of parts regardless of size, metal or alloy. Shows numerous parts produced. (47)

Ferrous Tubing. Tubular Products Div., Babcock & Wilcox Co., 4 pp, tables. Data card tabulating maximum allowable stress values for seamless and welded carbon, alloy and stainless pipe and tubing. (48)

Alloy Steel Castings. Unitcast Corp., 2 pp. Specifications, characteristics and uses of T-loy 42, alloy steel castings. (49)

Centrifugal Cast Parts. United States Pipe and Foundry Co., 12 pp, ill. Describes centrifugal castings process and advantages, and shows three applications improved by this method. (50)

Rigidized Metal Bonded Plywood. United States Plywood Corp., 8 pp, ill. Gives special features, advantages and wide variety of uses for Armoply, sheet metal bonded plywood. (51)

Prealloyed Steel Powders. Vanadium-Alloys Steel Co., 12 pp, ill, No. 3. Reprint covers the technology of Vasco prealloyed stainless steel powders, their properties and applications. (52)

Weldments. The Van Dorn Iron Works Co., 10 pp, ill. Shows this company's facilities for producing weldments and other parts in all sizes and shows examples of the type of work produced. (53)

Metal Shapes Tubing. Van Huffel Tube Corp., 24 pp, ill. Tables for metal shapes, lockseam tubing, butted tubing, welded tubing, angles and channels. (54)

Magnetic Alloys. Westinghouse Electric Corp., 8 pp, No. TD 52-100. Complete data on a variety of magnetic alloys produced by this company includes applications and 15 core loss and magnetization curves. (55)

Flanged and Dished Heads. Wickwire Co., 130 pp, ill. Comprehensive information and engineering data on C F & I flanged and dished heads, flueholes, handholes, saddles, etc. (56)

Nonferrous Metals • Parts • Forms

Precision Castings. The Adapti Co., Investment Casting Div. Brochure explains precision casting methods and shows by numerous applications how they are used. (57)

Aluminum Parts. Aluminum Goods Mfg. Co., 56 pp, ill. Catalog covers extensive production facilities and technical services for producing wide range of parts. (58)

Aluminum Castings. Aluminum Industries Inc., 4 pp, ill, No. 20A. Describes this company's facilities offered to industrial plants that need aluminum castings for defense jobs. (59)

Bonded Metals. American Nickeloid Co., 16 pp, ill. Fabricating information and suggestions, applications and tables of properties and sizes of Nickeloid Metals. (60)

Precision Investment Castings. American Precision Casting Corp., 8 pp, ill. Shows the steps involved to obtain precision investment castings using the "lost wax" process. (61)

Magnesium Castings. American Radiator and Standard Sanitary Corp., 8 pp, ill, No. 377. Illustrates the facilities of this company for producing magnesium sand molded castings. (62)

Bronze Corrosion Resisting Alloys. Ampco Metal Co., 16 pp, ill, No. PI-2. Properties, corrosion resistance, available forms and applications of Ampco nonferrous alloys for process industries. (63)

Aluminum Alloys. Apex Smelting Co., 24 pp, ill. Discusses composition, typical mechanical properties, heat treatments and basic foundry applications of the standard aluminum alloys produced by Apex. (64)

Mechanical Spring Design. Associated Spring Corp., 64 pp, ill. Contains basic formulas and charts, reference tables, conditions of use and practical information on spring materials. (65)

Aluminum Bronze Die Castings. Aurora Metal Co., 8 pp, ill. Description, advantages and sample products of firm's vacuum die casting process. Technical details of alloys used. (66)

Beryllium-Copper. Beryllium Corp., 16 pp, ill. Variety of applications of beryllium-copper in wide range of industries described. (67)

Copper-Base Alloys. Bridgeport Brass Co., 4 pp. Compositions, properties, forms and typical uses of 65 commonly used copper-base alloys useful to users of copper alloys. (68)

Bronze Bar Stock and Bearings. Bunting Brass & Bronze Co., 72 pp, ill, No. 52. A complete presentation of this company's standard stock bearings, graphited Oilless bearings, precision bronze bars and electric motor bearings. (69)

Precision Castings. Cadmet Corp., 8 pp, ill. Precision ferrous and nonferrous castings by the "lost wax" process. (70)

Titanium, Aluminum Alloy Steel Forgings. Consolidated Industries Inc., 4 pp, ill. Profusely illustrates a complete line of precision forgings made of these materials. (71)

Magnesium Forms. Dow Chemical Co., Magnesium Div. Technical information on magnesium, its available forms and applications. (72)

Die Cast Parts. The Electric Auto-Lite Co. Die Casting Div., 16 pp, ill, No. G137. Describes facilities for the economical manufacture of quality die castings. (73)

Chromium Carbides. Firth Sterling Inc., 4 pp, ill. Properties and uses of chromium carbide-nickel and chromium carbide-titanium carbide-nickel compounds. (74)

Short Run Stampings. HPL Mfg. Co., 4 pp, ill, No. 718. Explains how this company's facilities permit the rapid, inexpensive production of small lots (25 to 25,000 pieces) of stamped parts for experimental or development work. (75)

Aluminum Extrusions. Harvey Aluminum Div., Harvey Machine Co., 8 pp, ill. Properties, characteristics and applications of a variety of aluminum extrusions produced by this company. (76)

Long Wearing Machine Parts. Haynes Stellite Co., 23 pp, ill. Booklet describes a few of the many machinery parts made of Haynes alloys. Also contains over 60 tables and photographs showing some of the sizes and shapes in which these alloy parts are being used. (77)

Die Castings. The Hoover Co., 12 pp, ill, No. 853. Shows this company's facilities for producing zinc and aluminum die castings. Includes design helps, describes applications. (78)

Magnesium and Its Alloys. Howard Foundry Co., 4 pp, ill. Physical and chemical properties, characteristics and application of magnesium and its alloys. (79)

Laminated Metals. Improved Seamless Wire Co., Inc., 6 pp, ill. Describes the importance and applications of laminated metals to modern industry. (80)

Sleeve Bearings. Johnson Bronze Co., 4 pp, ill. Discusses a variety of Johnson "King-Size" sleeve bearings produced by this company. (81)

Magnesium. Magline Inc., 8 pp, ill. Facilities for fabricating magnesium and producing sand castings. (82)

Titanium and Its Alloys. Mallory-Sharon Titanium Corp., 16 pp, ill. Current data on the properties of various grades of titanium and titanium alloys. (83)

Aluminum and Zinc Castings. Monarch Aluminum Mfg. Co., folder. File pages on this company's developments in aluminum and zinc castings. Each folder distributed kept up-to-date. (84)

Bearing Metals. National Bearing Div., 2 pp. Price list of this company's bronzes and babbitt metals for bearings, including No. 397 Silver Babbitt for replacing scarcer materials. (85)

Die Castings. Paramount Die Casting Co., 4 pp, ill. Facilities of this company for producing aluminum, magnesium and zinc die castings. (86)

Copper Tubing. Penn Brass & Copper Co., 6 pp, ill. Features of this company's seam-

MANUFACTURERS' LITERATURE

less copper tubing. Includes tables of safe internal working pressures of various tubing sizes. (87)

Investment Castings. Precision Metalsmiths Inc. Entitled "Pour Yourself an Assembly," this booklet describes this company's facilities for casting in 160 different ferrous and nonferrous alloys. (88)

Bushings. Randall Graphite Bearings Inc., 12 pp, ill, No. 100. Complete price list of bronze bushings and specially grooved bushings; specifications of bored and solid bronze bars. (89)

Titanium and Its Alloys. Republic Steel Corp., 32 pp, ill, No. 588. A practical working manual presenting some basic and fairly well substantiated data on commercial quality titanium and its alloys. (90)

Aluminum Extrusions. Revere Copper & Brass Inc. Features a simplified easy-to-follow section on standard tolerances of aluminum extruded shapes, presented in table form. (91)

Roll Formed Shapes. Roll Formed Products, 24 pp, ill, No. 1053. Shows production procedures and advancements in roll forming shapes from ferrous and nonferrous metals. (92)

Electroplated Gold. Technic Inc., 4 pp, tables. Technical data sheets on gold plating for electrical and electronic uses. (93)

Screw Machine Products. Westfield Metal Products Co., Inc., 4 pp, ill. Describes facilities for the production of a variety of machined nuts and screw machine products. (94)

Centrifugal Castings. Wisconsin Centrifugal Foundry Inc., 8 pp, ill. Foundry for centrifugal castings includes semi-machining and finish machining services. Chart of most widely used alloys: aluminum bronzes, manganese bronze, tin bronze and aluminum alloys. (95)

Nonmetallic Materials • Parts • Forms

Synthetic Rubber Sheet and Roll Goods. Acadia Div., Western Felt Works, 2 pp, samples. Ten samples clipped to chart of physical specifications. Durometer, tensile and elongation characteristics. (96)

Plastic Molding. Ackerman Plastic Molding Div., 4 pp, ill. Long run production of plastic parts by compression of plunger molding. (97)

Rubber Parts. Acushnet Process Co., New Bedford, Mass. Illustrates variety of rubber parts company can make to order. Request on company letterhead direct from Acushnet.

Adhesives, Coatings, Sealers. Adhesives & Coatings Div., Minnesota Mining & Mfg. Co., 8 pp, ill. A handy guide to the selection of adhesives, coatings and sealers best suited for individual problems. (98)

Plastic Pipe. Alpha Plastics Inc., 2 pp. Features the properties, uses and sizes of rigid polyvinyl chloride pipe. (99)

Polyethylene Plastics Products. American Agile Corp., 4 pp, ill, No. 10751. Describes products made of various grades of polyethylene, and gives their uses, advantages and physical properties. (100)

Wool Felt. American Felt Co. Includes Dept. of Commerce bulletin Commercial Standard 185-52 Wool Felt. 47 reference samples of industrial felts. (101)

Technical Ceramics. American Lava Corp., 12 pp, ill. A primer on a variety of technical ceramic forms and uses. (102)

Extruded Plastics. Anchor Plastics Co., 12 pp, ill. Applications of thermoplastic rods, tubes, shapes, range of extrusions and fabrication facilities. (103)

Aluminum Adhesive. Armstrong Products Co., 6 pp, ill. Features the properties of adhesive for bonding aluminum at contact pressure. (104)

Reinforced Plastics. Bakelite Co., 20 pp, ill. General information production methods, formulations and properties of Bakelite polyester resin lists of secondary materials suppliers. (105)

Balsa Wood. Balsa Ecuador Lumber Corp., ill. Brochure contains a number of sheets discussing various Kilndried Balsa lumber and Balsa products. (106)

Thermoplastics. Bassons Industries Corp., 12 pp, ill. Complete data on reinforced and formed plastics. Illustrates processing facilities. (107)

Ceramic Bodies. Centralab Div., Globe-Union Inc., 28 pp, ill, No. 720-10M. Comprehensive survey of this firm's ceramic production. Includes description of engineering properties of ceramics, design information, allowable tolerances, and indicates broad scope of ceramic products with data dimensions. (108)

Engineered Paper Products. Cincinnati Industries Inc., 16 pp, ill. Complete data on the new double crepe Cindus material called X-crepe that can be used like cloth, instead of rubber, in place of cork, and for jobs where no other material will do. (109)

Custom Extrusions. Conneaut Rubber & Plastics Co., 4 pp, ill, No. CR-53. Facilities of this company for producing a variety of precision made extrusions. (110)

Coated Fabrics. The Connecticut Hard Rubber Co. Uses, chemical, electrical and mechanical properties, and availability of heat resistant silicone rubber coated glass fabrics. (111)

Insulating Material. Continental-Diamond Fibre Co., 14 pp, ill. Bonded mica insulating material. Includes dielectric and machining specifications. (112)

Molded and Extruded Rubber. Continental Rubber Works, 8 pp, No. 100. Gives dimensions of molded and extruded rubber with cross sectional illustrations. Also condensed SAE and ASTM specification chart. (113)

Impregated Materials for Reinforced Plastics Molding. Cordo Molding Products Inc., 3 pp, CMP-GI. Description of formulations available for molding products of reinforced plastics. (114)

Glass Products. Dunbar Glass Corp., 4 pp, ill. Descriptions of this firm's various industrial glasses. Explains advantages of glass to the designer and gives physical properties. (115)

Cellular Rubber. E. I. du Pont de Nemours & Co., Inc., Rubber Chemicals Div., 8 pp, ill, No. 52. Contains part of an article on cellular rubber, this section showing ASTM system for specifying cellular rubber compounds. (116)

Glass-Fiber Products. Dynakon Corp., 4 pp, ill. Booklet gives advantages, applications and uses of Dynakon, a high-strength, plastic bonded, glass-fiber product produced in form of sheets, rods and molded sections. (117)

Custom Molded Plastics. Erie Resistor Corp., Plastics Div., 4 pp, ill. Illustrated tour through Erie's new Plastics Div. headquarters, showing equipment for manufactured custom molded plastics. (118)

Teflon. Ethylene Chemical Corp., 8 pp, ill. Complete data on a variety of molded and extruded Teflon parts, sheets, rods and tubing. Includes table of properties. (119)

Wood-Paper Laminate. David Feldman & Associates, 4 pp. Thin wood veneer laminated to paper for decorative, display, and other uses. (120)

Plastics Resins. Firestone Plastics Co., 6 pp. Features physical, electrical and chemical polyvinyl chloride and styrene properties. (121)

Plastics Parts. Franklin Plastics Div. of Robinson Industries, Inc., 6 pp, ill. Illustrates variety of plastics products and discusses this company's injection molding facilities. (122)

Molded Plastics. General Electric Co., Chemical Dept., 8 pp, ill, No. 1d/Ge. Properties, characteristics and applications of this company's molded thermosetting and thermoplastic parts. (123)

Plastics. General Industries Co., 16 pp, ill. Profusely illustrates the facilities of this company for producing a wide variety of low-cost custom-molded plastics. (124)

Rubber-to-Metal Adhesive. General Tire & Rubber Co., Chemical Div., 8 pp, ill, No. 4016. Complete data on Kalabond rubber-to-metal adhesive for noncorrosive solvent resistant bonding. (125)

Rubber-Cushioned Parts. General Tire & Rubber Co., 12 pp, ill. Describes General Silentbloc method of mounting, coupling or isolating moving machinery on rubber. Shows standard parts and specifications. (126)

Reinforced Laminates. Glastic Corp., 8 pp, ill. Description, properties and performance comparison of plastics, polyesters reinforced with Fiberglas for heavy duty electrical insulation. (127)

Vinyl Plastic. B. F. Goodrich Chemical Co., 16 pp, ill. Electrical, physical and chemical properties of Geon vinyl electrical compounds in the wire and cable industry. (128)

Self-Lubricating Bushings. Graphite Metalizing Corp., 8 pp, ill, No. 108. Describes Graphalloy grades for bushings and electrical uses. Bearing design data included. (129)

Corrosion Resistant Equipment. Haveg Corp., 16 pp, ill, No. C-10. Pipe, valves, pumps, fume systems, filters and condensers for corrosive installations. (130)

Plastics. Heil Process Equipment Corp., 3 pp, ill, Nos. 752, 753 and 754. Discusses the use of Rigidon plastics exhaust heads, duct fittings and ventilating ducts. Specifications included. (131)

Plastics. Hercules Powder Co., 4 pp, ill, No. CP51-4. Bulletin describes properties of acetates which make them good materials for toy manufacture. (132)

Glass Textiles. Hess, Goldsmith & Co., Inc., 31 pp, ill. An introduction to the use of glass fabrics in industrial production. (133)

Balsa Wood. International Balsa Wood

MANUFACTURERS' LITERATURE

Corp., 4 pp, ill. Facilities of this company for producing Silvery "Feather Brand" Balsa Wood. (134)

Electrical Insulations. Johns-Mansville, 32 pp, ill, No. EL-40A. Manual on Quinterra and Quinorgo — highly purified asbestos electrical insulations that are pyrolysis-resistant. (135)

Molding Powders, Etc. M. W. Kellogg Co., 20 pp. Buyer's Guide gives complete addresses of firms producing molded and fabricated materials and products made of Kel-F, a trifluorochloroethylene polymer offered by Kellogg. (136)

Industrial Lens. Lancaster Lens Co., 4 pp, ill. Shows a variety of industrial glass products produced by this company, and lists the many industries it serves. (137)

Electrical Insulation. Louthan Mfg. Co., 13 pp, ill, No. 49-E. Uses and specifications of Louthan insulations in mechanical, electrical, thermal and electronic fields. (138)

Industrial Porcelains. McDaniel Refractory Porcelains Co., 24 pp, ill. Descriptions, outstanding features and specifications of various types of industrial porcelain parts. (139)

Glass Products. McKee Glass Co., 16 pp, ill, No. 12-68. Describes types of glasses manufactured, their applications and facilities for large-scale production. Illustrates numerous products for home and industry, including electrical, laboratory, television and marine equipment. (140)

Plastic Components. Tri-Point Mfg. & Developing Co., 4 pp, ill. Discusses precision machined plastic components of Teflon, Kel-F, Nylon, Formica, Rexolite, polystyrene and polyethylene. (141)

Cast Plastics. Micalite Plastics Corp., 4 pp, ill. Announces the availability of Micalite cast plastics in small production runs at low cost. (142)

Laminating Resin. Narmco Resins & Coatings Co., 4 pp, No. NRC-503. Technical data on Hi-Temp Conolon 506, a high temperature resistant laminate. (143)

Animal Glue. National Association of Glue Manufacturers, Inc., 101 pp, ill. Methods for the proper utilization of animal glue in various industrial fields. (144)

Polyester Resins. Naugatuck Chemical Div., U. S. Rubber Co., 18 pp, No. NC-51-7. Technical data on a complete line of Vibrin polyester resins for contact pressure laminating, low pressure molding and casting. (145)

Molded Nylon. Nylon Molded Products Corp., 4 pp, ill. Presents easy method of calculating the materials cost for a nylon part. (146)

Rubber. Ohio Rubber Co., 4 pp, ill, No. F-426. Detailed tabulation of the properties of natural rubber and rubberlike material. (147)

Electrical Insulating Materials. Owens-Corning Fiberglas Corp., 36 pp, ill. Technical data and applications of a complete line of glass-base electrical insulating materials. (148)

Molded Rubber Parts. Parker Rubber Products Div., Parker Appliance Co., 4 pp, ill, No. 5201A1. Lists the many advantages of using Parker custom molded rubber parts in a variety of applications. (149)

Nonmetallic Perforated Materials. Pearson Industries, 4 pp, ill. Complete data on Acouperf, a nonmetallic perforated material combining a heretofore unknown degree of sound transparency with novel decorative effects. (150)

Fiber Glass. Pittsburgh Plate Glass Co., 4 pp, ill. Fiber glass insulation, yarns, strands and rovings for fabrics, electrical use and plastic reinforcement. (151)

Polyester Reinforcing Resins. Pittsburgh Plate Glass Co., 24 pp. Technical data on the Selectron 5000 series of polyester reinforcing resins. (152)

Reinforced Plastics. Plaskon Div., 6 pp, ill. Folder describes molding operation and gives physical properties of fiber glass reinforced alkyd molding compounds and their uses in home and industry. (153)

Thermoplastic Molding. Plymouth Industrial Products Inc., 4 pp. Presents plastics molding processes and facilities for low cost molded parts. (154)

Thermoplastic Extrusions. Pyramid Plastics Inc., 4 pp, ill. Extrusions, processes and facilities for continuous coatings, pipe, sheets and strips. (155)

Plastic Laminates. Richardson Co., 19 pp, ill. Complete data on laminated •Insurack, including physical and chemical qualities, examples of applications in tubing, bearings, gears, sheet, etc. (156)

Closed Cellular Rubber. Rubatex Div.,Great American Industries Inc., 8 pp, ill. Nonporous foamed rubber products for sealing, gasketing, cushioning, packaging and other uses. (157)

Teflon. Sparta Heat-Treat Co., Plastics Div., 4 pp, ill. Illustrates various Teflon moldings produced by Sparta, and includes a detailed table of typical properties of molded Teflon TF-1. (158)

Reinforced Fiber. Spaulding Fibre Co., Inc., 38 pp, ill. Industrial uses of reinforced fiber products, vulcanized fiber, laminated phenolic parts, forms. (159)

Sponge Polyvinyl Chloride Plastic. Sponge Rubber Products Co., 3 pp, ill. Outstanding features, physical properties and chemical resistance of unicellular polyvinyl chloride plastic. (160)

Ceramics for Electronic Products. Stupakoff Ceramic and Mfg. Co., 4 pp, ill, No. 653. Complete data on Glass 60 metal seals, ceramic-metal assemblies, electronic ceramic materials and printed circuits. (161)

Vulcanized Fiber and Laminated Plastics. Taylor Fiber Co., 4 pp. Basic properties of plastic laminates and vulcanized fibrous materials arranged in convenient tables. (162)

Liquid Polymer Epoxy Resin Combinations. Thiokol Chemical Corp. Folder and technical bulletins Nos. 111, 112 and 113, 1 p each. Technical data sheets on combinations of Thiokol liquid polymers with Bakelite Shell and Ciba Epoxy resins. (163)

Carbon and Graphite Powder. U. S. Graphite Co., 66 pp, ill. Attractively presents detailed information on Graphitar, a carbon and graphite material for seals, bearings, end plates, valves, piston liners, etc. (164)

To obtain literature appearing on these pages, please refer to easy-to-use reply card on pages 281 or 282

Industrial Plastic. Westinghouse Electric Corp., 36 pp, ill, No. B-3184-D. Properties, grades, shapes, sizes, machining and applications data on Micarta, an industrial plastic. (165)

Finishes • Cleaning and Finishing

Hot Dip Galvanizing. American Hot Dip Galvanizers Assn., Inc., 8 pp, ill. Discusses hot dip galvanizing, the problems encountered by galvanizers, and its capabilities. (166)

Aluminum Coating. Anodic Inc., 4 pp, with samples. Hard coating for aluminum, its properties and uses. (167)

Spray Painting. Conforming Matrix Corp., 5 pp, ill. Gives description, uses and advantages of this firm's spraying masks, mask washing machine, and spray painting equipment. (168)

Metal Washers. Despatch Oven Co., 12 pp, ill, No. 68. Presents complete line of metal washers for metal cleaning and treating applications. (169)

Degreasers, Washers, Processing Equipment. Detrex Corp., 4 pp, ill. Describes a variety of standard and custom-built degreasers, washers and processing equipment. (170)

Wear Resistant Coating. Electrolyzing Corp., 16 pp. Detailed data on the Electrolyzing Process for increasing the life and efficiency of metal parts subjected to wear, abrasion and corrosion. (171)

Abrasive Stone. Elgin National Watch Co., Industrial Products Div., 1 p, No. 101. Price list of silicon carbide and aluminum oxide abrasive stones for stoning tools and dies, prefinishing and changing molds. (172)

Pickling and Activating Agents. Enthone Inc., 3 pp. Properties of Actone 33 pickling agent for cleaning steel, titanium and aluminum. (173)

Plating Anodes. Federated Metals Div., American Smelting and Refining Co., 8 pp, ill. Information on copper lead, zinc, tin, tin-lead cadmium, cadmium oxide and brass plating anodes. (174)

Baked Enamel. The Glidden Co., 12 pp, ill. Nebelon-S, a high hardness, stain resistant, flexible baked enamel finish. (175)

Pickling Inhibitor. E. F. Houghton & Co., 4 pp, ill, No. 2-555. Advantages of using Acitrol 3129, a liquid pickling inhibitor for cutting steel production costs. (176)

Electrodeposited Nickel. International Nickel Co., Inc., 8 pp, ill, No. A-153. Reprint on properties of electrodeposited nickel, and what influences them. (177)

High-Pressure Cleaners. J. P. Mfg. Co., 4 pp, ill. Typical applications of the new 2500 Series Whirlpool high pressure cleaners that degrease, wash, strip and clean in one operation. (178)

Metal Cleaning Products. Kelite Products Inc., 6 pp, ill, No. 121. Discusses a complete line of metal cleaning products for use in modern metal finishing. (179)

Colored Silicone Finishes. Midland Industrial Finishes Co., ill. Reprint interestingly discusses the application of colored silicone finishes. (180)

Liquid Blast Cleaning Equipment. Pangborn

Corp. Features, specifications and applications of this company's equipment for finishing of molds, dies, tools and other parts. (181)

Electrostatic Spray-Painting. Ransburg Electro-Coating Corp., 11 pp, ill. Describes new Ransburg No. 2 electro-spray process, its uses and advantages. (182)

Vacuum Impregnation. F. J. Stokes Machine Co., 24 pp, ill. Production equipment for high vacuum drying-impregnating processes for electrical components, castings, etc. (183)

Heat Treating • Heating

Steel Hardening Compound. Doughty Laboratories Inc., 24 pp. Step-by-step outline covers the various methods of application and also includes case histories showing successful application to wide variety of tools and parts. (184)

Rotary Hearth Furnaces. Gas Machinery Co., 4 pp, ill, No. A-102. Complete specifications of the Gasmaco rotary hearth furnaces for forging, annealing, heat treating or drawing operations. (185)

Electric Furnaces. Hevi Duty Electric Co., 6 pp, ill, No. HD-153. Specifications and advantages of using Hevi-Duty 2600 F electric furnaces incorporating silicon carbide heating elements. (186)

Carbo-Nitriding Furnaces. Holcroft & Co., 4 pp, ill. Features advantages and operation of this firm's case hardening equipment. (187)

Heat Treating Units. Ipsen Industries, Inc., 4 pp, ill, No. T-19. Complete data on the Ipsen Series T 100% forced convection controlled atmosphere heat treating units. (188)

Combustion Equipment. C. M. Kemp Mfg. Co., 27 pp, ill, No. B-11. Tells how combustion equipment offers fuel savings, is easier to install and to maintain, cheaper to operate. (189)

Induction Heating Equipment. Lepel High Frequency Laboratories, Inc., 36 pp, ill. Applications and specifications of a complete line of induction heating equipment for heat treating, metal joining, melting, etc. (190)

Gas Fired Vertical Radiant Type Furnaces. Lindberg Engineering Co., 4 pp, ill, No. 241. Design and application features of Lindberg carbonitriding as well as carburizing annealing, carbon restoration and other hardening jobs. (191)

Surface Hardening Stainless Steels. Lindberg Steel Treating Co., 24 pp, ill. Gives complete data on the Malcomizing process for surface hardening stainless steels. Seven case histories are included. (192)

Principles of Heat Treatment. Meehanite Metal Corp., 43 pp, ill, No. 40. Detailed data on the principles of heat treatment as they pertain to Meehanite metal. (193)

Electric Furnaces. Pereny Equipment Co., 3 pp, ill, No. 4A. Booklet tells advantages and illustrates typical group of this company's furnaces and kilns and their uses. (194)

Heat Treating Accessories. Stanwood Corp., 16 pp, ill, No. 16. Describes variety of heat treating accessories, including baskets, retorts and carburizing boxes. (195)

Quenching Oils. Sun Oil Co., 8 pp, ill, No. A-2658. Complete data on Sun quenching oils, which can handle 95% of all quenching jobs in industrial heat treating. (196)

Electric Radiant Panels. Edwin L. Wiegand Co., 4 pp, ill, No. L-1093. Detailed specifications of the new Chromalox electric far-infrared radiant panels for heavy-duty industrial heating, drying and curing operations. (197)

Industrial Furnaces. Lee Wilson Contracting Co., 8 pp, ill. Illustrations of more than 14 furnace types for many large scale industrial uses. Gas, oil and electric heat treating furnaces. (198)

Welding • Joining

Welded Parts. Acme Tank & Welding Div., 4 pp, ill. Shows this plant's facilities for welding complex shapes and discusses advantages of using welded construction by competent welders. (199)

High Temperature Fastenings. Aero Div., H. M. Harper Co., 16 pp, ill. Complete list of screws, bolts, nuts and washers of high temperature corrosion resistant alloys and titanium. Includes tables of chemical and mechanical properties. (200)

Arc Welding Machines. Air Reduction Co., 44 pp, ill, No. 1340. Discusses a.c. and d.c. inert gas welding machines. Specifications, features and electrical data for 20 different models are included. (201)

Low Hydrogen Electrodes. Alloy Rods Co., 6 pp, ill. Recent developments in the low hydrogen electrode field reviewed. (202)

Welding Analyser. Brush Development Co., 2 pp, ill. Brief description of features, uses and advantages of the new Brush welding analyser, Model BL-213. (203)

Welding Electrode. Champion Rivet Co., 18 pp, ill. Bulletin tells how to choose and use the correct electrodes, and gives information on properties, diameters, polarity, current, etc. (204)

Weldment Assemblies. Continental Foundry and Machine Tool Co., 6 pp, ill. Advantages of large welded assemblies, typical applications, and production facilities available. (205)

Springtites and Sems. Eaton Mfg. Co., 40 pp, ill. Discusses various screw or bolt and washer assemblies. Size tables and manufacturing data are included. (206)

Solder Paint. Fluxolder Products Co., 22 pp, ill. Advantages, operations and uses of Fluxolder solder paint. (207)

Paste Alloy Solders. Fusion Engineering, 4 pp, ill. Flux-containing electrical, electronic and mechanical bond paste solders and brazing alloys. (208)

Resistance Welding. General Electric Co., 16 pp, ill, No. GEA 5816. Analysis of resistance welding and catalog of resistance welding equipment. (209)

Welding Speed Steels. W. J. Holliday & Co., 4 pp, ill, No. 907. Detailed information on welding Speed Case (X1515), Speed Treat (X1545) and Speed Alloy Plate. (210)

To obtain literature appearing on these pages, please refer to easy-to-use reply card on pages 281 or 282

Effective Use of Locknuts. Industrial Fasteners Institute, 23 pp, ill. Descriptions and principles of operation of representative types of locknuts. (211)

Aluminum Fasteners. The Jacque Co., 8 pp, ill, No. 50A. Price list and specifications of this company's line of aluminum fasteners. (212)

Rapid Arc Welding. The Lincoln Electric Co., 48 pp, ill, No. 444. Manual discusses methods of arc welding at high speeds and lower costs. Describes procedures for making various types of joints, and recommends electrodes. (213)

Designing for Welding. Linde Air Products Co., 20 pp, ill, No. F-7811. Reprints of articles stressing the economies of good welding design. Includes summary of standard welding symbols. (214)

Silver Brazing Preforms. Lucas-Milhaupt Engineering Co., 10 pp, ill. Features an interesting article on the advantages of using silver alloy preforms. Includes detailed specifications. (215)

Fasteners. Milford Rivet & Machine Co., 12 pp, ill, No. MM52. Detailed information on an integrated service of fastener research, design, engineering and production collaboration. (216)

Induction Brazing. The Ohio Crankshaft Co. "Typical Results of Tocco Induction Brazing and Soldering" shows by case histories the advantages of these fastening methods. (217)

Self-Clinching Fasteners. Penn Engineering and Mfg. Corp., 16 pp, ill. Gives dimensional data on this firm's self-clinching and self-locating fasteners. (218)

Screws. Russell, Burdsall & Ward Bolt & Nut Co., 8 pp, ill. Presents principle of fastening, advantages and specifications of a complete line of Spin-Lock screws available in hex, pan, truss or flat heads. (219)

Fasteners. Shakeproof Inc., 24 pp, ill, No. AS-42. Booklet shows numerous types of this company's fasteners so arranged as to help the designer choose the best fastener for his job. (220)

Fasteners. Simmons Fastener Corp. Literature describes fasteners especially designed for use in construction where easy demountability is required. (221)

Adjustable Fasteners. South Chester Corp., Southco Div., 4 pp, ill. Describes adjustable door fasteners for machinery doors. Said to be applicable quickly and resist loosening due to vibration. (222)

Self-Locking Nuts. Standard Pressed Steel Co., 4 pp, ill, No. 866-153. Properties and applications of various Flexloc self-locking nuts that lock and stay put on a threaded member. (223)

Bronze Welding Rods. Titan Metal Mfg. Co., 6 pp, ill. Chemical and physical properties of a variety of Titan bronze welding rods produced by this company. (224)

Slotted Place Bolts. The Townsend Co., 4 pp, ill. Operational characteristics and torque chart for slotted type place bolts. (225)

Forming • Casting • Molding Machining

Coated Abrasives. Armour Sandpaper Works, 124 pp, ill. Catalog of complete line of coated abrasives. Includes tables. (226)

Center Type Cylindrical Grinding. Carborundum Co., 40 pp, ill, No. 9. Offers the latest developments in the field of center

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type cylindrical grinding. Includes starting recommendation for average applications. (227)

Wet-Abrasive Cut-Off Machine. The Cincinnati Electrical Tool Co., 2 pp. Description, features, alternating and direct current specifications of this wet-abrasive cut-off machine. (228)

Deep Drawing Machine. The Cincinnati Milling Machine Co., 15 pp, ill, No. M-1759. Features, advantages and operation of the hydroform deep drawing machine for simple and intricate shapes. (229)

Presses. Denison Engineering Co., 16 pp, ill. Features the installation and uses of the Denison hydraulic Multipress. (230)

Metal Fabrication. Geuder, Paeschke & Frey Co., 12 pp, ill. Shows this company's facilities for fabricating and coating sheet metals for military production to customer's specifications. (231)

Semi-Automatic Presses. The Hydraulic Press Mfg. Co., 4 pp, ill, No. 5107. Gives description and specifications of H-P-M automatic compression molding presses for reinforced plastics molding. (232)

Die Casting Machines. Lester-Phoenix Inc. Folder gives description, features and specifications of this company's die casting machines and injection molding machines. (233)

Tungsten Carbide Compacting Tools. National Carbide Die Co., 4 pp, ill. Discusses various tungsten carbide compacting tools as they are applied to powdered metallurgy. (234)

Inspection • Testing • Control

Strain Indicator. Baldwin Lima Hamilton Corp., 2 pp, ill. Description of new portable strain indicator. (236)

Polishing Machines. Buehler Ltd., 8 pp, ill. Describes a variety of metallographic polishing machines for the metallurgical laboratory. (237)

Hardness Testers. Clark Instrument Inc., 4 pp, ill. Shows features of this firm's hardness testers and discusses their accuracy, speed of operation and durability. (238)

Pocket Thickness Gage. Ferro Corp. Describes pocket size thickness gage, said to give good accuracy for measuring non-magnetic coatings on ferrous surfaces. (239)

Measuring Instruments. General Electric Co., 64 pp, ill, No. GEC-1016A. Complete line of testing and measuring devices. 115 instruments are described, including ammeters, oscillographs, roughness scales, mass spectrometers, radiation monitors, amplifiers, etc. (240)

Temperature Controls. Claud S. Gordon Co., 4 pp, ill. Brief description and advantages of straight line, full automatic temperature control. (241)

Temperature Control. Illinois Testing Laboratories Inc. Description, wiring diagrams and applications of Alnor Pyrotac excess temperature cut-off. (242)

Nondestructive Testing Machine. Magnaflux Corp., 4 pp, ill, No. 16,001. Operating principle, advantages and applications of Duovec magnetic particle testing machines. (243)

Profilometer. Micrometrical Mfg. Co., 8 pp, ill, No. LT-77. Practical features and applications of the Profilometer for measuring surface roughness. (244)

Tensile Test Specimen Holder. Tinius Olsen Testing Machine Co., 2 pp, ill, No. 45. Description, operation and dimensional data on holders for rapid production testing of standard round tensile test specimens. (245)

Impact Testing Machine. Riehle Testing Machines Div., American Machine & Metals Inc., 6 pp, ill, No. RM-8-52. Booklet gives operating features and specifications of the Riehle Model PI-2 impact testing machine. Also illustrates other Riehle testing machines. (246)

General

Machine Tool Spacers. Hartford Special Machinery Co., 12 pp, ill. Technical data on a complete line of 8- and 12-in. machine tool spacers. (247)

Vacuum Pumps. Kinney Mfg. Co., Vol. V-51B. Complete details on Kinney vacuum pumps for every vacuum requirement. (248)

Chain and Belt Conveyors. Michigan Steel Casting Co., 8 pp, ill, No. 1-B. Shows Misco rivetless chain conveyors and Woodman belt conveyors for high temperatures. (249)

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News of Societies

Thirty-six men were promoted to and within professorial ranks in the *University of Illinois College of Engineering*, and five were added to professorial staffs. Stanley H. Pierce, who becomes associate dean of the college this fall, was advanced from associate to full professor of general engineering.

Edward H. Platz, Jr., manager of alloy sales, Lebanon Steel Foundry, was appointed chairman of the *Public Relations Committee, Alloy Casting Institute.* Brad B. Evans, Empire Steel Castings, Inc., and C. M. Ruprecht, Electro-Alloy Div., American Brake Shoe Co., were named to serve with Mr. Platz.

Dr. Adolph Meyer will be awarded the *George R. Henderson Medal* by *The Franklin Institute of the State of Penn.* for his outstanding accomplishments in the gas turbine field. The award will be presented at the annual Medal Day Ceremonies. On the same day, the Institute will present to Robert Franklin Mehl, director of the Metals Research Labs. and professor of metallurgy at Carnegie Institute of Technology, the *Francis J. Clamer Medal* for his major contributions to the fields of metallurgy and metallography.

The *Malleable Founders' Society* has scheduled the following meetings for the current fiscal year. General Society Meetings will be held Sept. 25, 1953, and Jan. 22, 1954 in Cleveland, Ohio. The Annual meeting will be held June 14-15, 1954 at the Seigniory Club, Quebec Province, Canada. Western Section Meetings will be held in Chicago on Oct. 23 and Nov. 20, 1953; and on Feb. 26, Mar. 26, Apr. 23, May 21, and July 23, 1954. Eastern Section Meetings will be held in New York City on Nov. 6, 1953, Mar. 5, and May 14, 1954.

Corrosion problems affecting pipelines, oil refineries and aircraft will be the principal topics of discussion at the 3d Annual Conference of the *National Association of Corrosion Engineers,* Western Region, Nov. 19 and 20 at the Biltmore, Los Angeles. Devoted to the task of improving and standardizing corrosion preventive practices, the N.A.C.E. is now taking a leading part in establishing test methods and engineering principles that will prolong service life and conserve equipment. Technical papers will be presented during the afternoon session on Nov. 19 on gas and water pipeline corrosion. The morning of Nov. 20 will be devoted to papers on corrosion as it affects the aircraft industry.

(More News on page 292)

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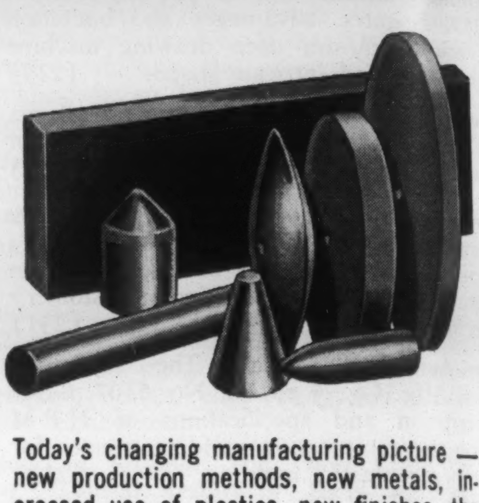

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The Editor's Page

Peep Show

Last month we reported on an interesting use of plastics in connection with human surgery. Now we hear of another use which takes care of the ambulatory patient. Just to show how ingenious man can be when circumstances spur him on, we pass on this information: Tiring of pulling out his shirt tail every time he wanted to show his scar, a recent victim of an appendectomy had his wife sew a sheet of clear plastic into one of his shirts. Now when he says, "Wanna see my operation?" all he has to do is pull his coat aside and there in a nicely framed panel is the ugly, red gash.

What's This?

On a recent tour through the Aluminum Research Laboratories one of our fellow editors spotted a sheet of strange looking material. Asked he, "Is this translucent aluminum new?" Turns out the object of his attention was a sheet of plastics being used in comparative tests.

Aluminum Temple

Speaking of aluminum, as we just were, reminds us of our recent guided tour through Alcoa's new building in Pittsburgh. In this building, now formally opened, aluminum is used functionally in every way possible. In some respects the building is a branch of the company's research laboratory, for the light metal is being used in many new and unusual ways. Some of the applications are experimental and will serve to give Alcoa experience which will be useful in future years. Some of the developments in the building are already being used in other new buildings throughout the country. As to the building itself, it is an extremely interesting structure. The design and decoration of the interior is so attractive as to almost make it a pleasure to go to work there.

Face Lifting

Unlike a ship, a magazine is never referred to as a she—merely an it. However, both ships and magazines need an occasional face lifting, refurbishing and a new paint job. Thus, we introduce our new cover which you probably have noticed by this time. We think all of our recent covers have been attractive, but this tops them all in our opinion. As you will observe in the future, this cover can be changed in several ways depending upon the whims of the editors, and still maintain its basic identity.

Sore Foot Time

That annual harbinger of fall, the Metal Show is again upon us. Soon we will be tramping about Cleveland's huge Exposition Hall developing a new crop of blisters and callouses. Perhaps exhibition halls should install moving belts such as are being proposed in New York to move people from Times Square to Grand Central.

A New Solvent

Startled is a mild word for our reaction the other day when we noticed this headline in the infallible *New York Times:* "New Process Uses Water As A Solvent". It seems to me that the oldest processes used water as a solvent. What they were talking about was a new enamel which uses water as a solvent and thereby achieves many important advantages over the usual enamels for many applications.

What's In A Name

Perhaps Shakespeare would have some apt comment apropos the battle over what to call parts made by the powder metallurgy process. For a while "sinterings" had a strong lead, but then the tide of battle changed and that name lost its appeal. The battle still is not over, but while an armed truce prevails, the term "powder metal parts" will hold the fort. Perhaps that is not ideal, but at least there is no question as to what is meant.

T. C. Du Mond
Editor